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POPULAR MECHANICS

SEPT. 1965
35 CENTS

Special Home Issue

Instant Office in a Closet

3 Great Hobby Corners

Practical Sound Proofing

10 Brand New Materials

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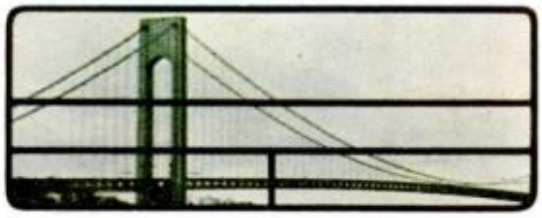

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(The VW has twice as much room as most wagons, so we have room for a lot more windows.)

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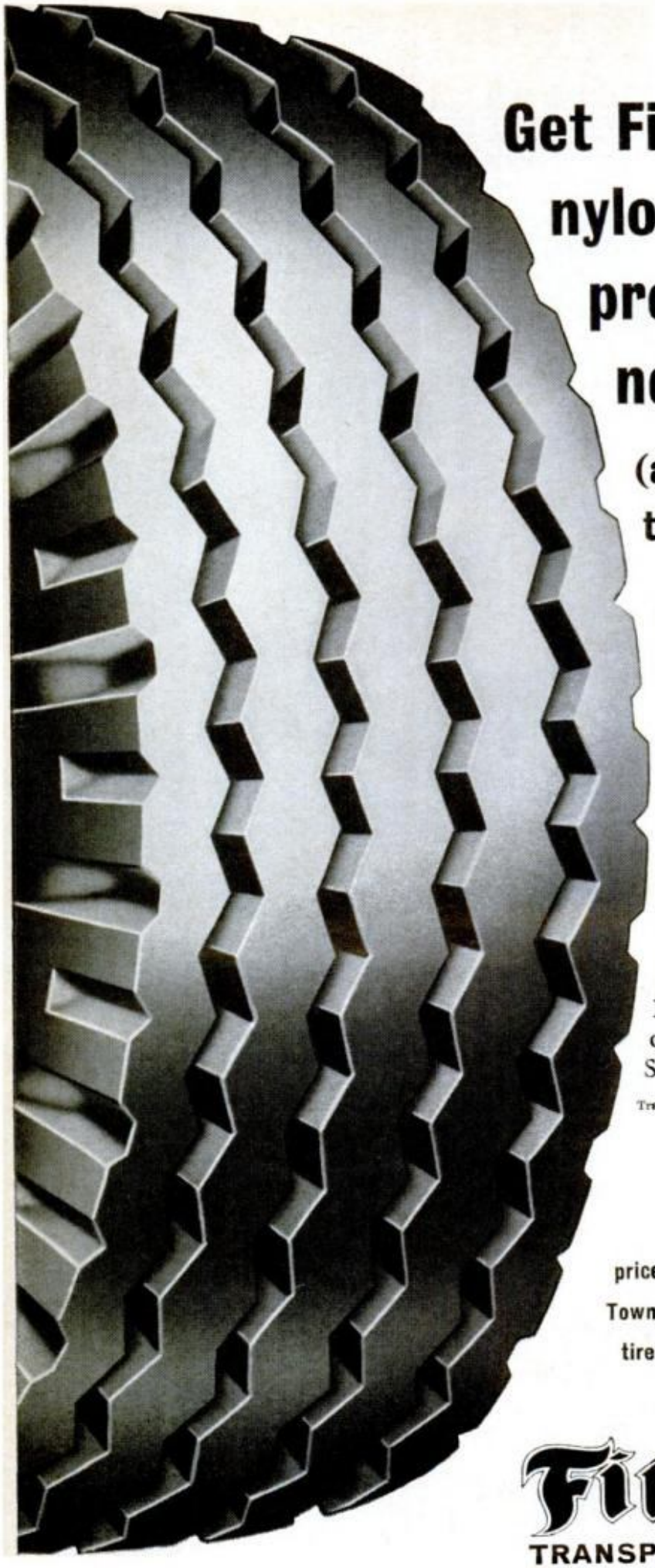

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AUTOLITE

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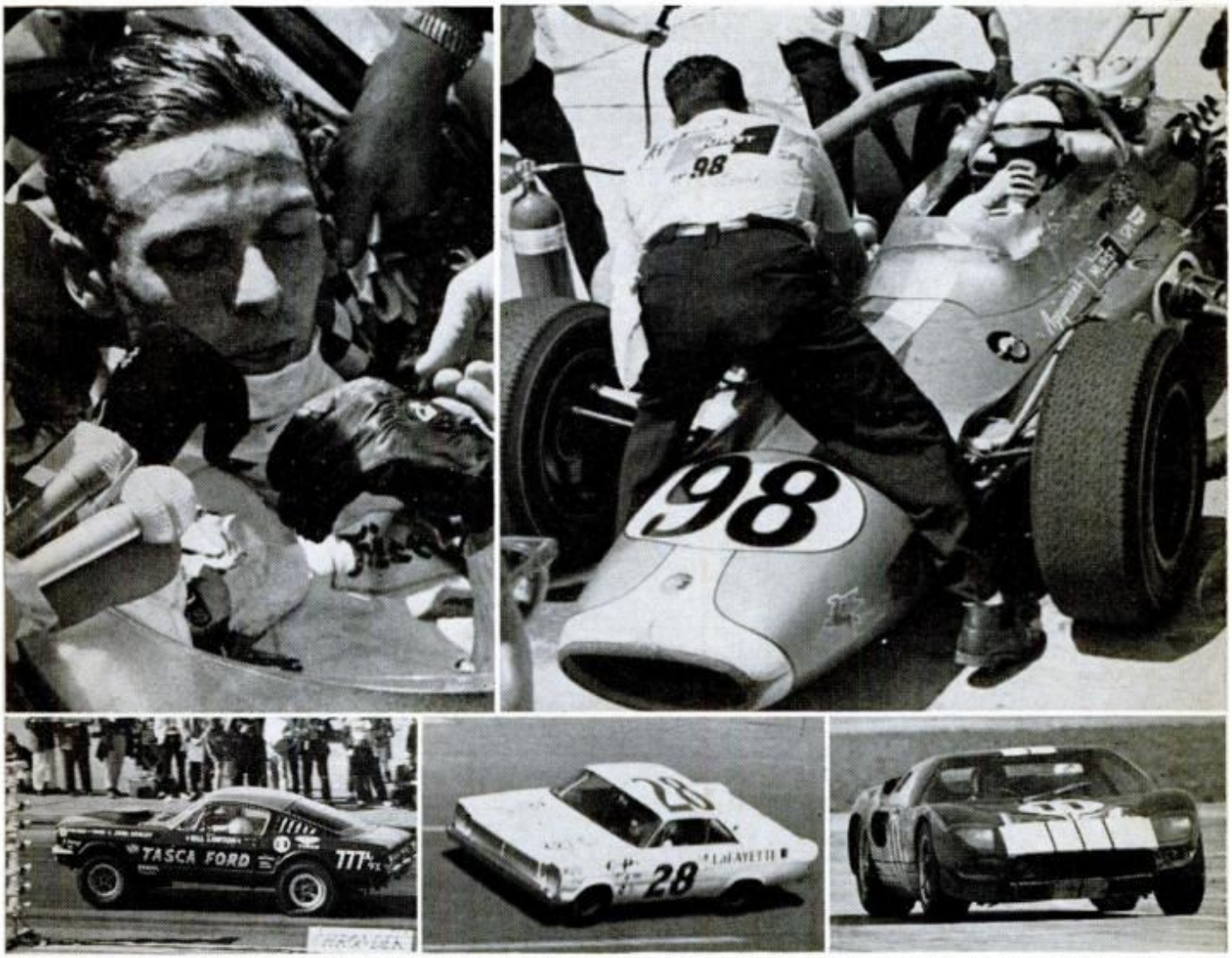

If you think that Autolite's 1-2-3-4-5 finish was an accident, take a look at the record. 8 out of 11 finishers in the '65 Indy 500 rode with Autolite. In the Daytona 500, Autolite-equipped cars took the first 15 places. The first 10 cars across the line in the Riverside 500 used Autolite. The World 600 in Charlotte was conquered by an Autolite-equipped Ford, and at the Winternationals, an Autolite-sparked Mustang nailed down the Top Factory Stock Eliminator title.* An Autolite-equipped Ford GT knocked Ferrari out of first in the Grand Touring prototype class at Sebring. Why not ride with a winner? It doesn't cost any more.

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POPULAR MECHANICS

SEPTEMBER 1965
VOL. 124 NO. 3

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Special Home Section

House Floats Inside Itself 126
Grab Bag of New Prefabs 128
New Materials for Quick Remodeling 133
New for Your Home 138
Leaner Look in Home Building 140
Great Hobby Corners in Waste Space 144
Wrap Yourself in Quiet 152
6 Ways to Put Crawl Space to Work 160
3 Smart Light Fixtures 164
Solving Home Problems 166

Features of Special Interest

Breedlove's Own Story of How He'll Drive 750 MPH 88
Sizzling Enigmas at the Edge of Space: Quasars 94
They Help Stamp Out Firebugs 98
I Hit the Ground at 150 MPH 104
Bag It with a Bow 106
Home Brew: Fine Paper from a Tub 112
PM Tracks Down the Ozark Spooklight 116
Miniature World of Microcircuits 120

For the Workshop Craftsman

Power Leaf Blower Beats Raking 170
Sliding-Top Cocktail Table 175
Checking Out Your Car's Wiring, Part I 177
Step-Toolbox for Skippers 183
Do-Them-In-Your-Head Navigation Tricks 184
Make a Model Tesla Turbine 188
Interflex Sound: A New Hi-Fi Speaker System 194

Regular Departments

Over the Editor's Desk 8
Science Worldwide 12
News from the Services 16
Detroit Listening Post 20
Sidelights on Aviation 22
Items From All Outdoors 24
Clinic for Homeowners 28
Take Charge of Your Career 30
Marine Spotlight on the Wayne-100 . 38
New for Camera Buffs 40
New on the Market 44
Noteworthy New Inventions 46
Worth Writing For 58
Auto Clinic 182
Outboard Clinic 186
Shopping for Tools 187

Материал, защищенный авторским правом

NEXT MONTH you'll ride Detroit's '66s with PM's auto editors; the Petty brothers tell you what to look for in a car race so you'll know what's going on; a brand new outboard boat hits the water. October PM also brings you the latest plans for a built-in storage wall you can take with you, plus a rundown on glass cutting.

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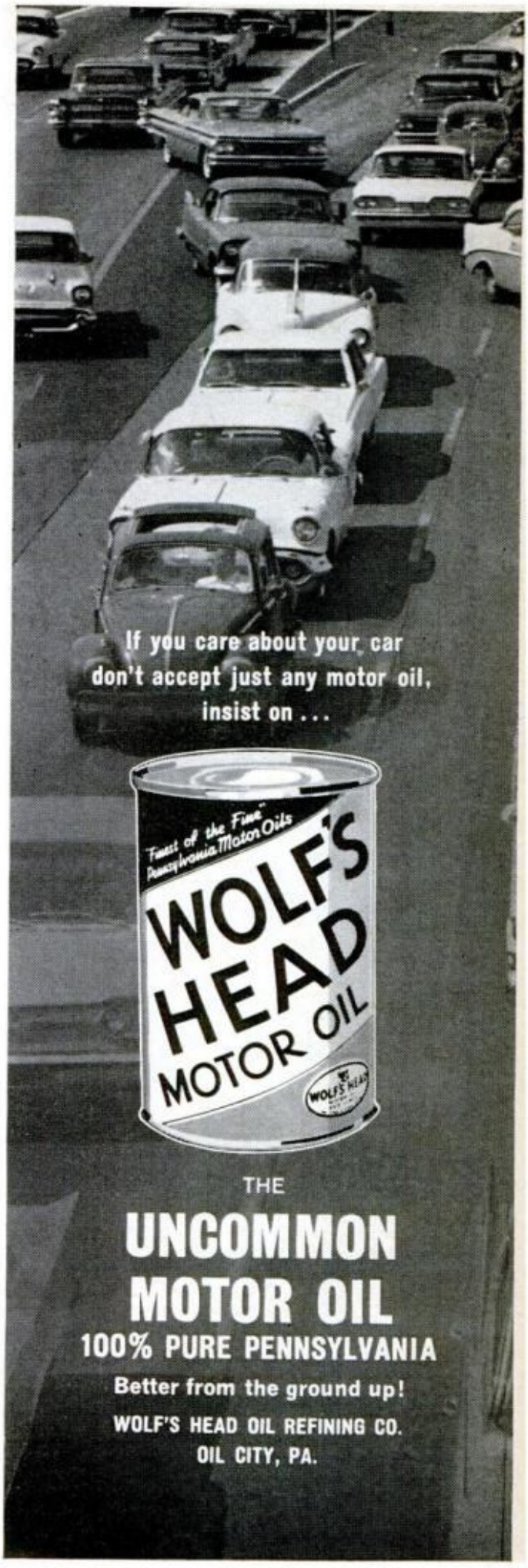

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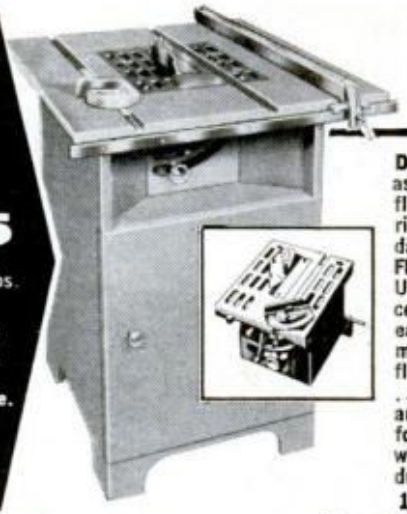

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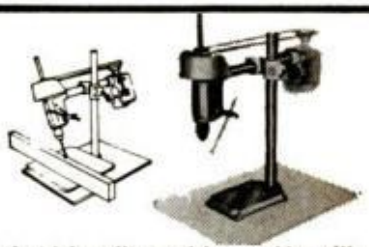

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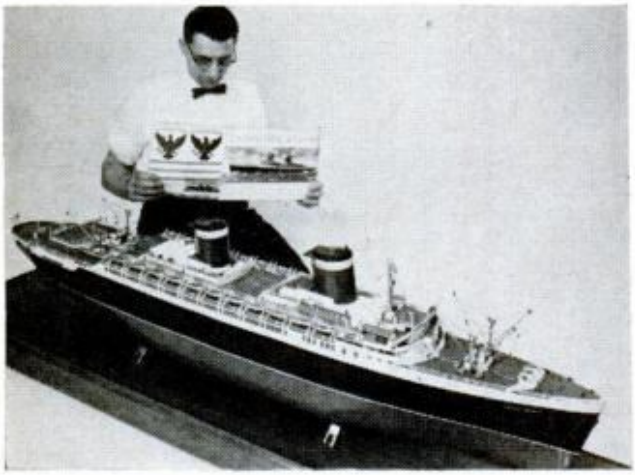
Over the Editor's Desk

Twice as Big

My six-foot model of the SS *United States* is based on drawings in your five-part article *36-Inch Model of the SS United States*, which started in December 1952 (page 182).

Besides being twice the size of the *PM* model, mine has more detail. I have spent



hours aboard the ship, photographing and dimensioning details for this project.

The model was built in seven months. The hull is built up solid. Deck details are from white Plexiglas, brass and white metal castings.

Union, N.J. R. E. HEYMAN

Lots of Punch

Put Punch in Your Vise (page 182, March *PM*) offers a very good idea, but I still think that the way I have of making gaskets, washers and other punched materials is better in some ways.

I make the punches of tool steel, but I put a half-inch shank on them and chuck them into my drill press and cut the material by rotating the punch. I also combine two punches in one so as to make the centerhole and outside cut at the same time. The center punch is adjusted so it cut through the material first, and then the outer punch cuts.

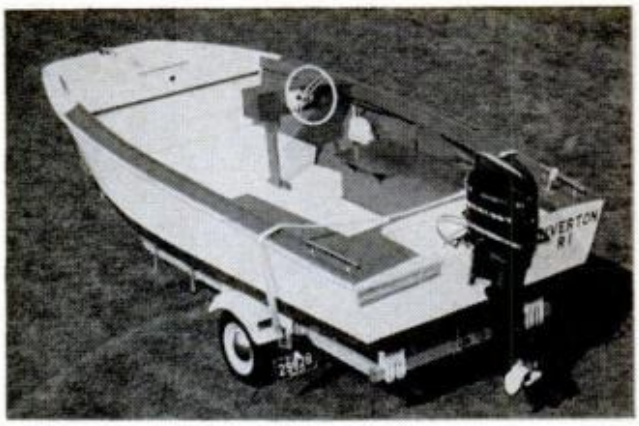
This system seems to work far better in cutting cork gaskets that seem to want to tear when done by pressure.

Too, I bore the centers of the cutters *straight* so that continuous sharpening does not change the size—as I merely grind the *outside* to sharpen (usually with an oil stone with the cutter held in a lathe).

Vero Beach, Fla. JAS. "ART" WILSON

Happy Sledder

Everyone who has seen the *PM Sports Sled* (page 144, March 1964 *PM*) that we



built thinks that it's great—and we're proud of it.

We use a 50-hp Mercury on it with an 11-inch blade.

Portsmouth, R.I. JOSEPH S. DEBIASIO

Every Ride a Thrill

My *Hydro Dynamic* (page 144, March 1963 *PM*) gives me a thrill every ride I take, and it has lots and lots of speed.

When I built the boat, I made several changes. I put upright braces between each frame and used 2 by 6s on both sides

of each sponson. In addition, I made the transom with double ¾-inch plywood.

I have a 100-hp Mercury on the boat, and it really works nicely.

Kramer, N.D. STANLEY ROMSOS

One Less Glider Pilot

I was surprised to see the old *PM* glider in your January issue (page 26). My brother and I made the same glider last summer.

We found the plans in an old book published by *PM* in the early 1900s. The project took only about two or three weeks, and the cost was quite low. There was a little difficulty in stringing the piano wires, but otherwise it was quite easy to make, and the plans were easy to follow.

The real difficulty came in flying it! The photograph shows us getting the feel of it

(Please turn to page 10)

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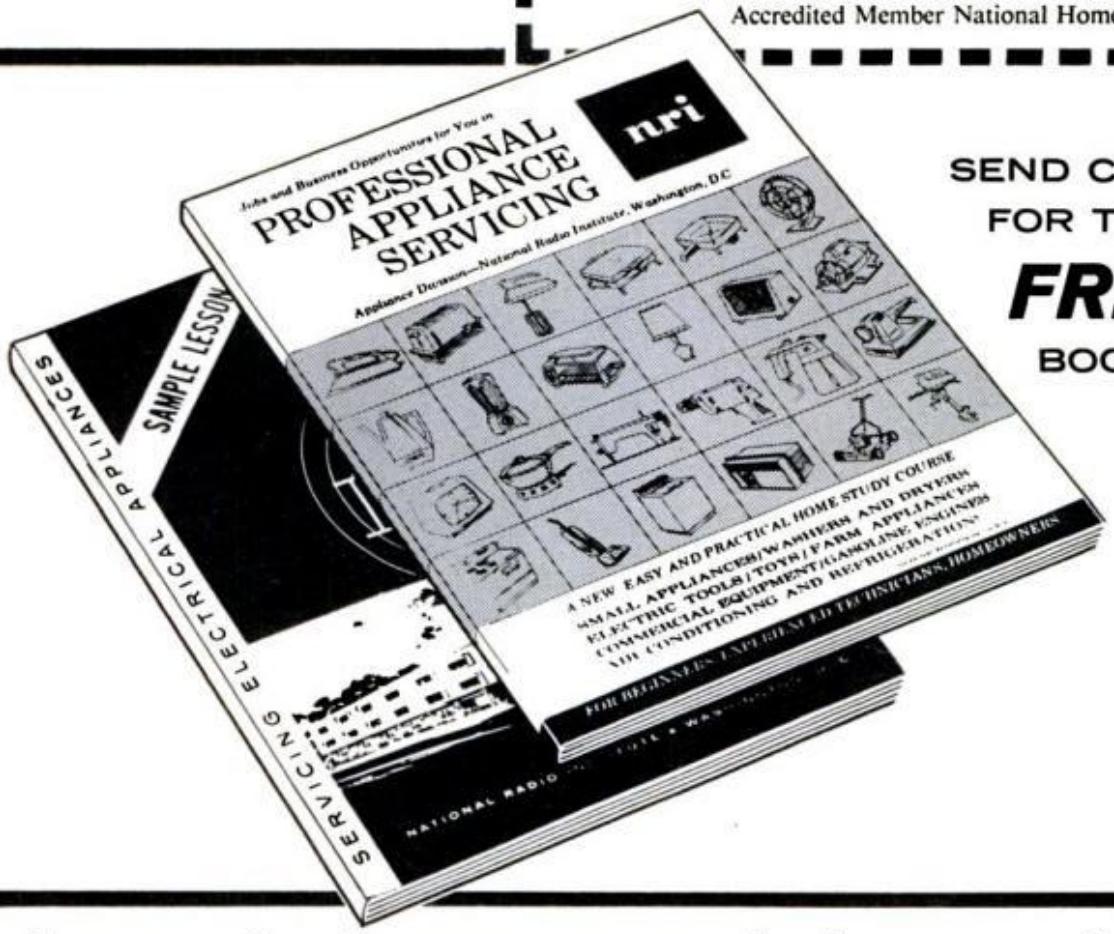

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Over the Editor's Desk

(Continued from page 8)

by running in our yard. Unfortunately, there are no photographs of the first (and last) flight.

On a fairly windy day, a gang of bloodthirsty friends helped me carry the glider to a large, steep hill nearby. I ran over the edge. It sailed beautifully for several seconds until suddenly a strong gust of wind caught the front. I had the sickening feeling that I was going up and backwards. Fearing the worst, I let go, and dropped about 15 feet as the glider sailed over my head. It soared up and then crashed into

pieces against the hill. Fortunately, I lived through it and suffered only from a sprained ankle and several bruises.

In your January article you asked how many men would jump off a cliff in a home-built glider. I can tell you for sure there's one less than the number last year.

Pittsburgh, Pa. BLALOCK BAHNSON

Not Fiction

In the March 1961 *PM* there was a glowing article, *More Horses Per Gallon?* (page 113), touting a gasoline supplement called GS-1000. This product was supposed to provide extra power, greater miles per gallon, more complete and cleaner combustion and reduction in operating costs.

Now that a period of time has passed, whatever happened to GS-1000? Did time prove it the boon to mankind that this article said it was? Or has it passed into the annals of press-agentry fiction?

Curundu, Canal Zone ARTHUR M. MCKRAY

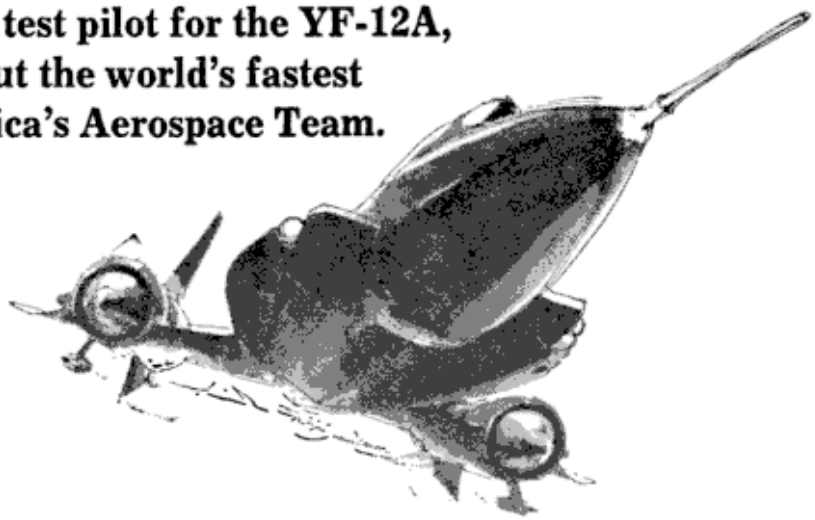
Western Editor Tom Stimson who wrote the article, reports: "Fuels Research Service Company of Denver tells me that the firm is selling over a million dollars worth of GS-1000 every year.

"Instead of 'press-agentry fiction,' the story was a reader service article, informing PM *readers of a new product in a field in which they are interested."*

The Editors

Материал, защищенный авторским правом

Capable of speeds better than 2,000 mph, the YF-12A is the hottest aircraft around. Now Maj. Walter F. Daniel, test pilot for the YF-12A, answers your questions about the world's fastest manned airplane and America's Aerospace Team.



(Maj. Daniel, a test pilot since 1954, is a member of the Society of Experimental Test Pilots. He received a B.S. degree in Aeronautical Engineering from the University of Oklahoma. In February 1962, he set world class time-to-climb records in a T-38 jet trainer.)

How fast has the YF-12A flown?

On May 1 of this year the YF-12A (formerly known as the A-11) reclaimed the world absolute speed record from the USSR. It was clocked at 2,062 mph over Edwards Air Force Base.

How big is the YF-12A?

The exact dimensions of the YF-12A have not been released yet. But it's approximately 100 feet long, with about a 50-foot wingspan. That's half again as big as our present interceptors!

What can I do to get on the Aerospace Team?

If you're going to college, you can join Air Force ROTC, or apply for the Air Force Academy. That way, you'll receive your commission as an Air Force officer at the same time you get your degree. If you're not going on to college, Air Force enlistment is open to you.

Must I be a high-school graduate to get in the Air Force?

At the moment, it's not a requirement. However, the overwhelming majority of airmen do have their diplomas. You see, the more advanced aircraft and rockets become, the more education you need to work with them. At the very least, stay in high school and graduate.

What are my chances of working with an aircraft like the YF-12A?

If you have the right aptitudes and ability, they're good. Of course everyone can't be a test pilot or astronaut. But whatever your Air Force job, you're part of the Aerospace *Team*. Your job is essential to the success of the Air Force mission.

How are Air Force jobs assigned?

Before you enlist you're given an "Airman Qualifying Examination." This test measures your aptitude in four separate career areas. The job you get is based on the scores you make—plus your own desires and the needs of the Air Force.

What sort of training will I receive?

First, you'll have 6 weeks of basic military training at Lackland Air Force Base, near San Antonio, Texas. After that you'll go on to a technical training school or on-the-job training. It costs thousands of dollars to train a man up to Air Force standards, but it gives him a skill that becomes more and more valuable every day.

Can I keep up my studies while I'm in the Air Force?

The Air Force *encourages* its men and women to continue their educations. For instance, you may qualify to study for a degree during off-duty hours, with the Air Force paying a substantial part of the tuition.

What kind of a future do I have in the Air Force?

A bright one. As we move further into the Aerospace Age, the Air Force is going to grow even more important. And you can grow with it!

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For reasons that officials can't fathom an octopus at the West Berlin aquarium has taken to nibbling on its own tentacles and ignoring its regular diet of fish, mussels and crayfish. Two of its eight 6-foot legs were half eaten away during a 10-day period, its keepers report. At that rate, by the time you read this the unfortunate fellow may resemble a soggy medicine ball.

There's at least one other case of a self-ingesting octopus on record.

Frozen tomatoes are in your future. Up to now, freezing methods haven't worked well with tomatoes. But a new approach looks promising. Very low temperature freezing with liquid nitrogen, according to the Department of Agriculture, produces good quality fresh-frozen tomato slices.

Solar energy is keeping the cows out of the crops in Britain. A new device absorbs the sun's rays and converts them into electricity—enough to charge a small battery, which produces pulses of current in a steel fence.

Old Faithful is really two geysers in one, according to a government geologist. He says his studies show that the famous geyser has two different cycles of eruptions. One occurs every 45 to 55 minutes, the other after a period of 60 to 85 minutes. The different cycles lead the geologist to think that two separate cauldrons supply the geyser.

Control by eyeball may be necessary for future spacemen. NASA feels the task of controlling complex future spacecraft could exceed man's manual ability. Space-age speeds dictate an immediate response. It may simply take too long for sensory cues to be transmitted to the brain, translated into motor commands and then retransmitted to the hands and feet.

So scientists are now working on a device to follow the motion of the eyeball by tracking a beam of light reflected from the cornea. This motion would be converted to electronic signals that would instantly maneuver the spacecraft.

If three islands off Australia's southern coast are washed into the sea, blame it on the rabbits. A government official says that the animals have eaten all the vegetation and that, as a result, the islands are rapidly eroding.

Here's how to make that pineapple houseplant bloom: enclose it in a plastic bag with an apple for a few days.

That's the word from a Department of Agriculture researcher who has been studying the effects of growth-regulating substances on ornamental plants. He says the ripe apple gives off ethylene gas, which promotes blooming. In tests, he's obtained large clusters of small flowers on plants within one to six months of their being bagged with an apple.

A pair of atomic frequency devices now are keeping the nation's master clock at the Naval Observatory, Washington, D.C., constant to about one second in 300,000 years. Data from a year of study show the twin atomic hydrogen masers are about 100 times more accurate than any other device presently used in the precision control of time interval.

The masers use the transition of hydrogen atoms to establish frequency. Tests show these devices deviate from each other by only a few parts in 10 trillion parts.

Common use of lead-lined cooking, eating and drinking vessels by the upper classes may have led to the downfall of Rome. That's the theory of a California scientist, who explains that the toxicity of lead was unknown in classical times.

Lead poisoning interferes with the fertility of men and especially of women. Sufficient amounts of lead, he says, bring women to "sterility, miscarriage, stillbirth, or premature labor: children born to such women are apt to die shortly after birth."

The poor of Rome had no such problem, not having the means to buy lead-lined pots and the like. So they remained healthy while the aristocrats dwindled in number.

The fastest shot ever fired was blasted out of a 20-foot gas gun at NASA's research center near Mountain View, Calif. A plastic projectile about one-third the size of a shirt button was propelled at 25,300 mph, a record for controlled flight of a visible object of a known mass and shape.

(Please turn to page 14)

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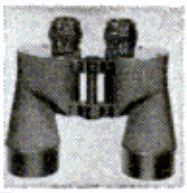

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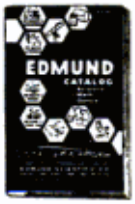


Science Worldwide

(Continued from page 12)

The gas gun works something like a child's popgun. An explosive charge is set off in a cylinder behind a plastic piston. The explosion pushes the piston into a chamber of hydrogen gas, compressing it, and the gas in turn propels the projectile.

The ability to move objects at extremely high speeds is required for research into the effects of small meteorites on spacecraft hulls and astronauts' space suits.

✔ ✔ ✔

When the air's charged, stay in bed. A study by the World Meteorological Organization shows that more accidents of all kinds occur when there's a lot of electricity in the air.

✔ ✔ ✔

An ancient civilization's secrets may make Israel's Negev desert inhabitable. The Negev is a barren land of irregular and sparse rainfall. Scientists have found extensive remains of large settlements throughout the desert, dating from about 200 B.C. to 700 A.D. and indicating a peak population of about 100,000.

It seems the ancient farmers were extremely skillful in conserving rainfall through the use of intricate retaining terraces. Scientists say that weather conditions haven't changed during the centuries. It's possible that the old methods could be used today, thus opening the land for settlement.

✔ ✔ ✔

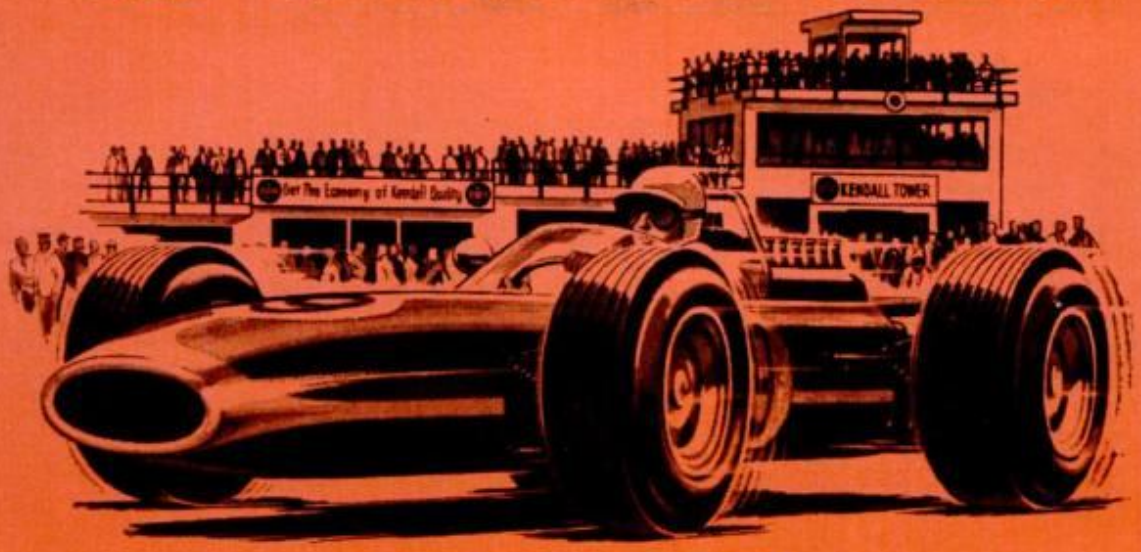
Purest salt in history has been made in a Pittsburgh laboratory—but it's for scientific experiments, not eating. The crystals, two feet long and half an inch in diameter, are far more transparent than the clearest glass. They have fewer impurities than 10 parts per billion—the equivalent of having only 30 impure atoms in as many atoms as there are human beings on earth.

✔ ✔ ✔

Biggest solar furnace in the world is now being built in France. Covering 42 acres, it will have 11,000 small mirrors reflecting the sun's rays to a parabolic mirror more than 146 feet high and 195 feet wide. At the furnace, just over 97 feet from the mirror, the temperature will reach 6300 degrees F. The furnace will be used for industrial research and for studying the effects of extreme heat on materiel and engines used in space craft.

John F. Pearson
Science Editor

AT WATKINS GLEN



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Sidelights from the SERVICES

By William R. Kreh

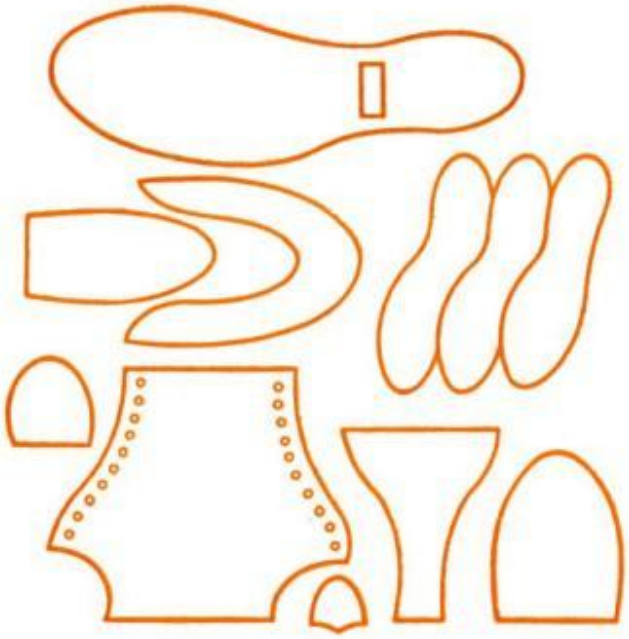
A desk-sized television console that operates like a miniature TV studio has been developed for the Department of Defense to televise military briefings. The console, complete with camera, microphone, lights and monitors, can be operated by a briefing officer to relay TV pictures of maps, charts and other material to Pentagon offices via a closed circuit. The system lets military people see and hear up-to-the-minute reports on military situations without leaving their offices.

A cushion of air provides a bump-free method of carrying wounded on a ground-effect litter being tested by Army medics. The litter's 3-hp lawnmower engine can carry a load of 200 pounds.

Navy Seabees—a special team of 60 of them—will do the work at "sensitive" foreign construction jobs from now on instead of foreign workers. The State Department disclosed recently that hidden microphones were planted by foreign workers during construction work on embassies in Moscow and Warsaw.

Slumping has drawn increased attention from the Navy. That's the term given underwater landslides which occur on the sea floor. The Navy would like to know what effects this slumping would have on structures built on the ocean bottom. Navy scientists are using a lake in California for tests because it has been found to have slumping similar to the sea floor.

Underwater repair shop. The Navy might turn the giant atomic sub USS *Triton*, which sailed around the world submerged, into an under-ice repair and tow ship for nuclear-powered missile subs. One of the problems facing the Navy is what to do if an A-sub gets stuck or damaged while operating under the polar icecap. The *Triton* could carry spare parts and scuba divers to make repairs on the disabled sub. If the damaged sub can't be repaired underwater, the *Triton* could lash herself to the sub and pull her to open water. The *Triton*'s twin reactor powerplant and twin screws give her plenty of reserve power for towing.



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detroit listening post

- *How safe is the newly paved Langhorne race track?*
- *Dodge—out to get sports cars*
- *More discs, but the price isn't right*

A. J. Foyt is one of the half dozen most accomplished drivers today, but he was so angered by the crashes in the first **Langhorne, Pa.,** race after the track was paved that he vowed never to race there again. In this summer's 100-miler, 11 of the 22 starters went out in a series of spins and crashes. For nearly 40 years the track had been a dirt circle; now it's paved and shaped like a D.

"On most tracks, there are two or three grooves you can run in," A. J. said. "But there, you're running on the ragged edge all the time and there's only one groove. Something happens in front of you, and you've had it. I think maybe they'll get it fixed, though—and if they do I might run there again."

Look Out, SCCA. Dodge's plans to campaign the sports car circuit this year may be on the back burner, but they're still cooking. Some **Dodge** people harbor strong feelings against "sporty cars" and fairly drool at the prospect of **Dave Pearson's** thundering hemi "eating up all those little foreign jobs."

"We'll take 'em," one vowed. "If they try to go around him, Dave will probably open his doors."

A well-intended piece of misinformation helped me mislead you in the **Olds** owners report (page 232, March '65 *PM*). Several owners noted, as we did, a wildly erratic gas gauge. As fuel seemed to slop around in the tank, the needle responded —enthusiastically. **Olds'** man told us, "There may be a few such gauges, but if he has one it's covered under warranty —tell him not to worry." A reader waved his copy of *PM* under the dealer's nose, but was told, in effect, to go away. We checked with Lansing again and this time they confessed they'd goofed. "The gauge is *not* replaceable" (under warranty).

What can I say after I've said I'm sorry?

Factory-installed disc brakes are finally here for smaller **Chrysler Corp.** cars—**Valiant, Barracuda** and **Dodge Dart.** So I spent a weekend in a **Kelsey-Hayes** disc-equipped **'Cuda.** These brakes aren't immune to fade, but they resist it well. You no longer have to accept serious brake problems in these cars. To cook the linings to the fade point, you must mistreat them until they howl for mercy. The fully equipped 'Cuda gets to 90 mph fast. I slammed back down to 0 even faster at least a dozen times, with no delays for cooling. The hot linings stank and it became impossible to lock the wheels, but braking still was firm, smooth and even. When cooler linings began to recover, braking still was even.

But **Chrysler** asks $97.30 for the option, while **Ford** gets $58 for similar **Kelsey-Hayes** discs.

Oldsmobile's up-coming Toronado, the front-drive competitor for **Ford's T-Bird,** was never called the "Holiday"—even within the company. The experimental job number, and the term most used in **Lansing,** was the **XP-784.** Because of its extreme hood length and soft-line styling, it was also called the **"E-job"**—in reference to the **E-type Jaguar.** Similarities end with the skin, however.

A stock car tire that won at **Darlington** this year, then ruled out by **NASCAR,** may be the coming thing for **Indianapolis.** Tubeless racing tires, because they run cooler, have been a goal for years. But air seepage had designers stymied. The individually welded stock car wheels have a porous area that lets air seep out. Magnesium wheels, like those used at **Indy,** have a similar problem; it's basic to "mag." But **Firestone** developed a coating for the inside of the wheel that sealed its pores—much like the coating in self-sealing passenger car tires. The **NASCAR** requirement for inner liners in all four tires on long tracks wrote off the tubeless idea for stocks, but **Indy** has no such problem.

An English lady motorist was stopped recently by a suspicious bobbie who noticed a foot sticking out of the trunk of her car. The "corpse," it turned out, was the lady's husband—and he was very much alive. The car's fuel pump had quit, so he had climbed into the trunk to work the plunger by hand.

Automotive Editor

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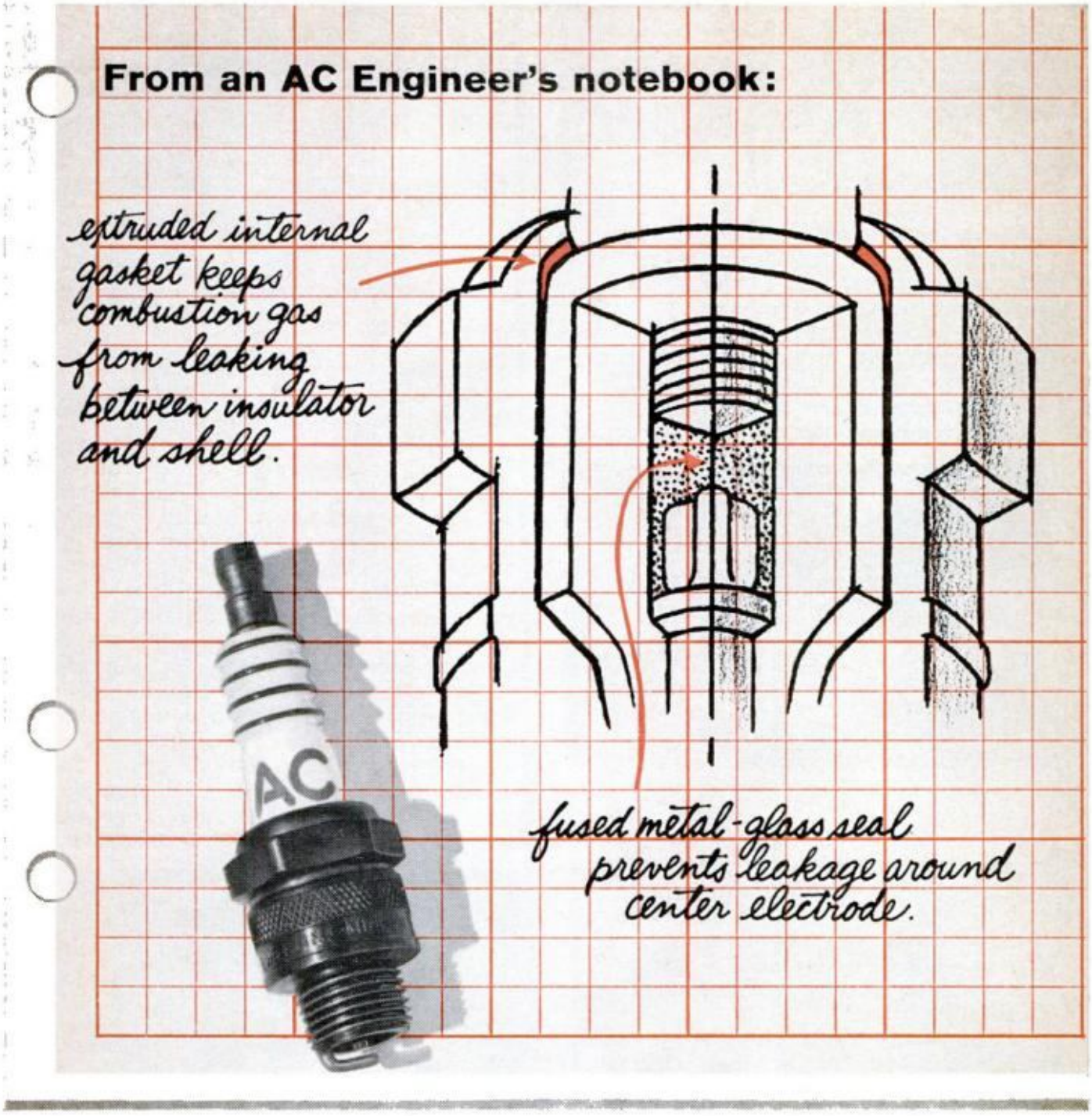

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Our man in Paris, Richard Thomas, attended the recent Paris Space and Air Show and sent us the following report:

Let's face it, the Russians scored a thumping victory here. Their 250-ton, 720-passenger transport, Antonov 22, with a total of 66 tons of thrust in four 8-blade turbojet engines, threw an almost electrical charge into the international audience that gathered at Le Bourget.

Most American correspondents on the

PROPOSED C-5A, at 350 tons, may be largest of all

scene tended to play down the big craft as a slow, lumbering leviathan. But the Russians didn't send the An-22 to amaze our correspondents. They sent it to impress Europeans who were there in droves, and any impartial observer will acknowledge that the Europeans were thrilled by it.

Word got around quickly that this plane, which has been flying since January, is bigger and huskier than our proposed C-5A, which is still under design competition by Lockheed, Douglas and Boeing aircraft companies. The assumption is doubtful. Donald W. Douglas Jr. of Douglas Aircraft Co. told this correspondent that the jet giant, on which all three are competing, will weigh in at about 350 tons and will have double-deck space for about 1000 passengers. However, except for the French edition of *PM*, this statement received no publicity in Europe, while the Soviet plane made front-page headlines across the continent.

Comments heard at the air show give a clue to the feelings of the crowd. A French press officer said to an American correspondent, "At 250 tons, it weighs considerably more than any plane you have in the United States at this time."

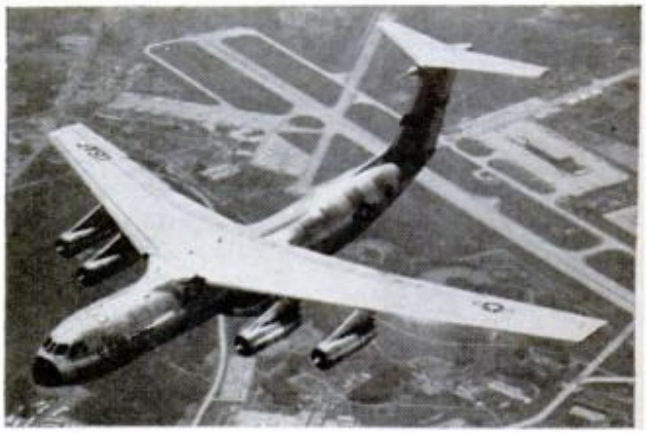
Two Russians, who thought their language gave them privacy, were overheard by this reporter as they discussed some of the heavier aircraft. One spoke of the U.S. Air Force's Lockheed C-141 *Starlifter*, currently our largest operational

RUSSIAN An-22, 250-ton giant, stole Paris show

cargo plane at about 160 tons takeoff weight. "Oh," said the other, "you mean that baby carriage."

A visitor from the Mediterranean said, "The Americans sure go out of their way to put on a spectacle. They cracked up a B-58 at the 1961 show, and they cracked up another one at this year's show. I wonder what they'll do next."

United States prestige did rise somewhat when a Lockheed XH-51A helicopter flew better than 250 mph, a speed no other rotor-craft can match, and when a few Navy and Air Force fighters skimmed the field at supersonic speeds. Sending over Vice President Hubert Humphrey and Astronauts James McDivitt and Edward White did some good, but the press on the Continent characterized this as a measure of desperation.



U.S. C-141, at 160 tons, is largest we have now

On the other hand, America did have a golden opportunity of scoring a real hit. If the Air Force had taken the wraps off the YF-12A and let her fly flat-out at Mach 3 point-to-point, she could have flown New York to Paris in one hour and fifty minutes. The news of an approaching American plane that had left New York 110 minutes earlier would have bounced us back into first place in this show on which we reportedly spent several million dollars.

Kevin V. Brown
Aviation Editor

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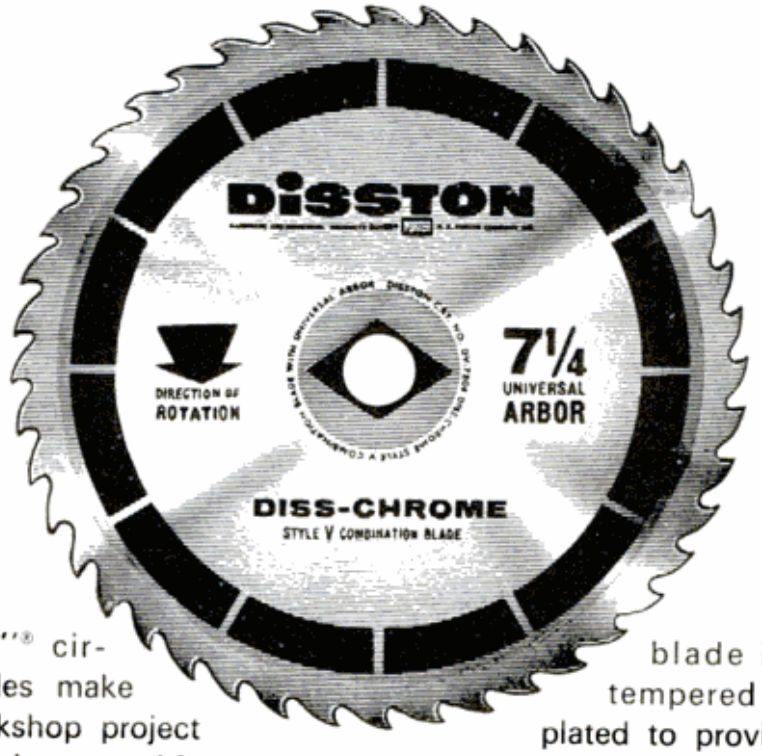

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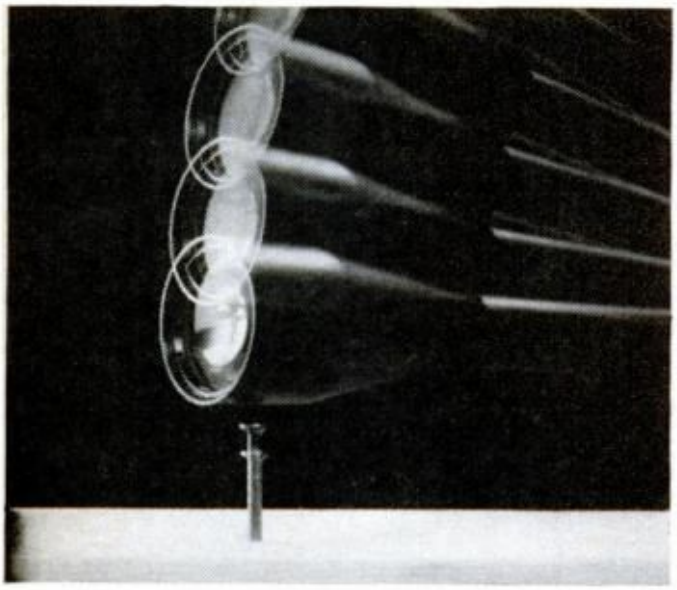

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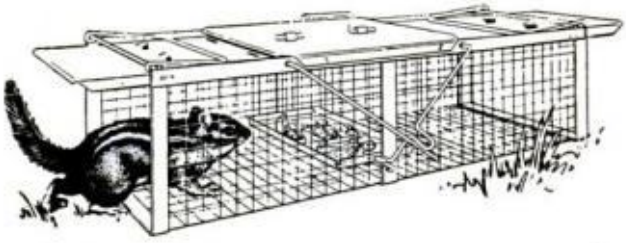
RIFLE SCOPES

Items from All Outdoors

Humane trapping has interested me ever since I ran a line of leg-hold traps in my youth, so for the past eight months I've had an avid 12-year-old naturalist in California using the Havahart animal trap that is shown here. His first report came in February. *"Jan. 1—12 cats; Jan. 2—7 cats; Jan. 4—4 cats; Jan. 24—one old stray cat. Finally got bored of just catching cats."* But we urged him to persevere



and since then he has caught squirrels, raccoons, opossum and even several birds. And all were in perfect health. In his last report he said, *"You can tell the people that this is a great trap. You have to get tough with kids who mess around with it, and cats are always getting into it, but it catches lots of animals and never hurts them."* You can get more information from Allcock Mfg. Co., North Water St., Ossining, N.Y.

Having seen more than one canoe clobbered on a sharp rock, I raised an eyebrow at the announcement that every Grumman Aluminum canoe would be guaranteed for the lifetime of the purchaser. So I talked with the sales manager for Grumman Boats and learned that there are certain reservations—the guarantee does not cover accidents, and it does not cover white water usage.

Keeping pants cuffs inside a pair of arctics has long been a problem, but now an inventor, C. T. Troy, has come up with a cure for this nuisance. A rubber flap attached to the tongue of the arctic slips into the pants cuff, holding it down. A strip of foam rubber attached to the rear of the arctic keeps out the snow. I tried it last winter and it works perfectly. Called "Komfort Kit," it sells for $1.49 from Snowproof Arctics, Box 682, West Chester, Pa.

Stuart James

Outdoors Editor

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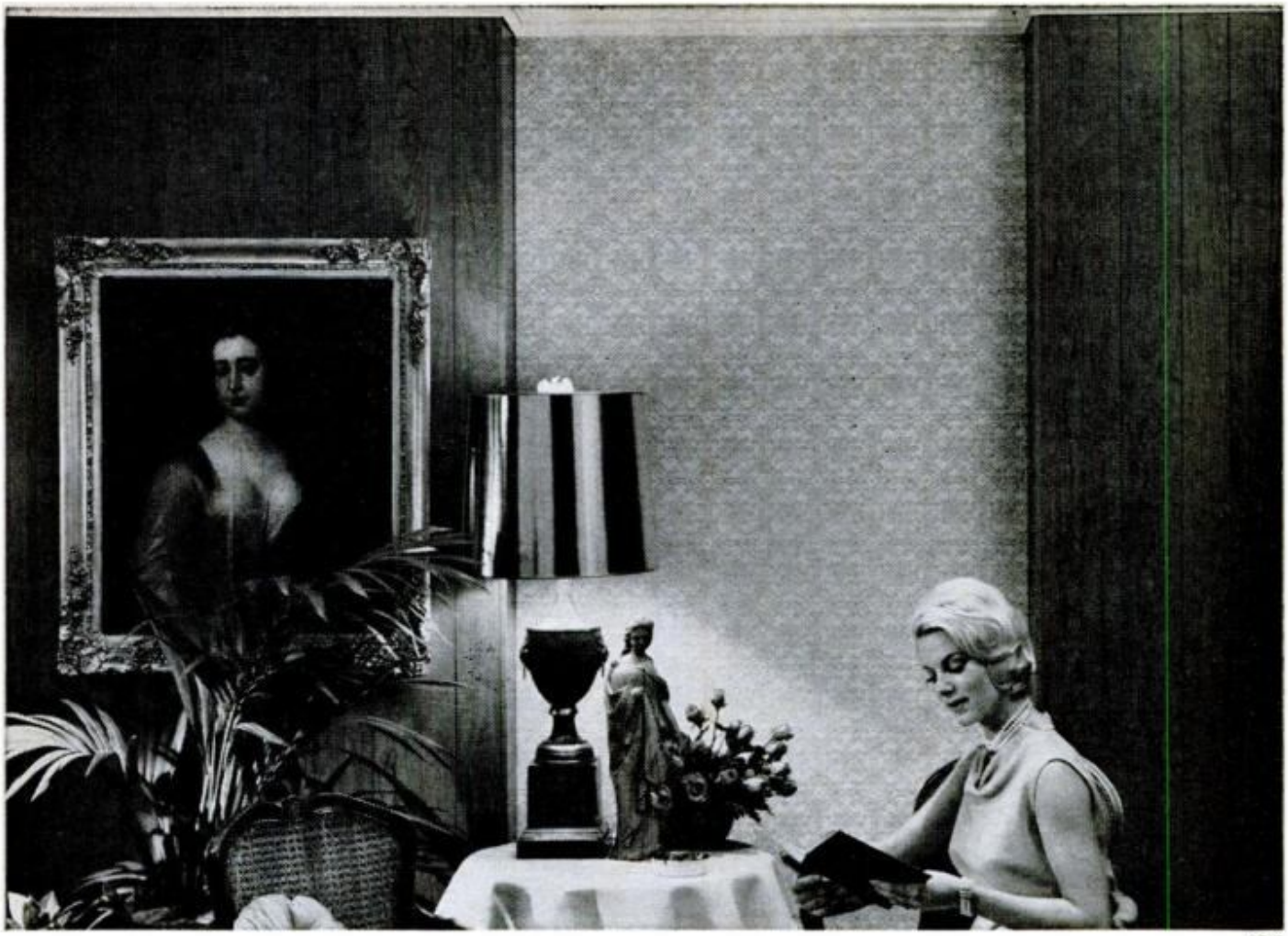

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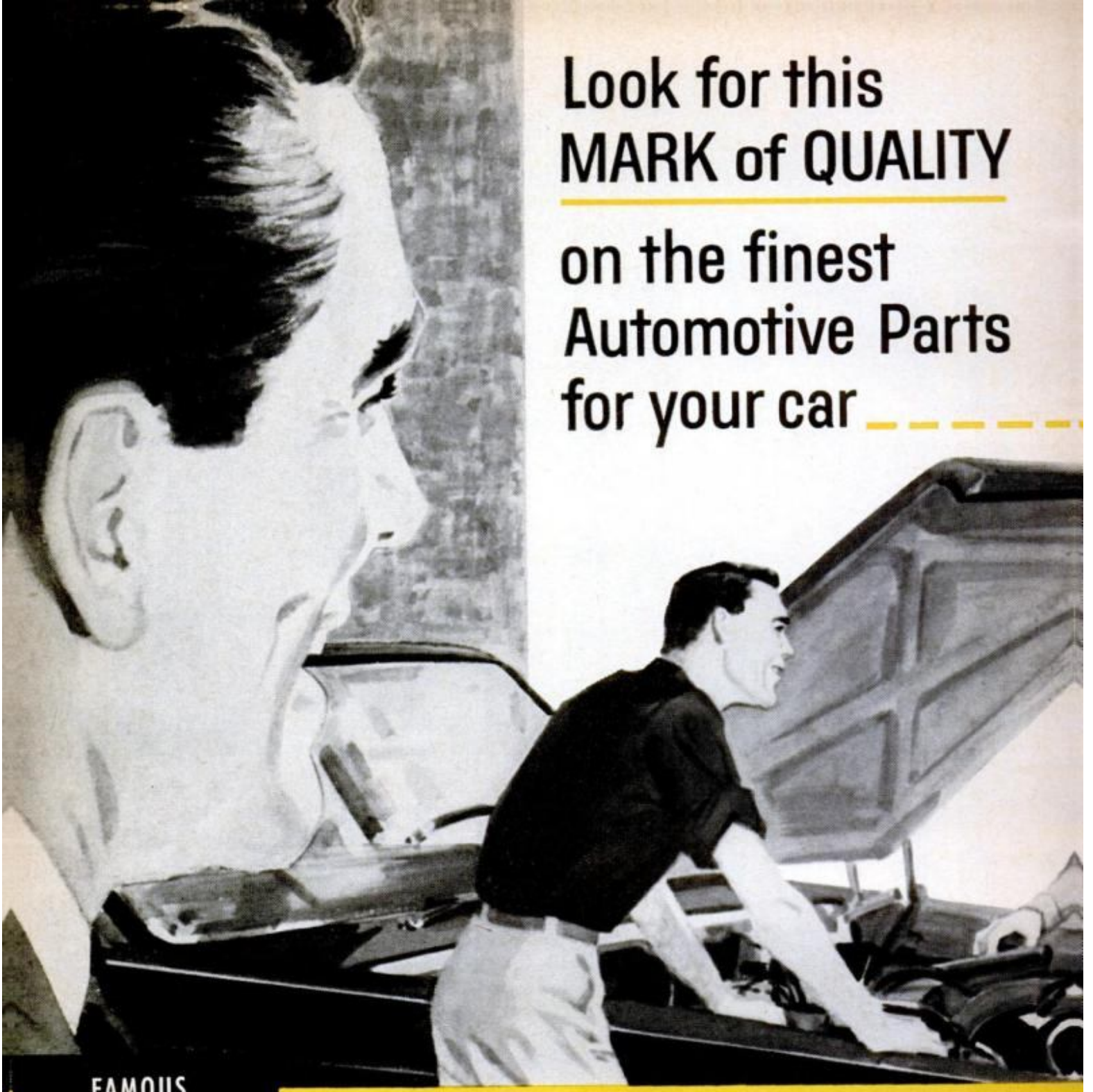

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CLINIC FOR HOMEOWNERS

Q I've read and heard a lot about these so-called "breathing" house paints. The claims that are made just don't seem reasonable to me. Is the paint coating actually porous when dry? If it's porous, if it breathes as they say, then how can it shed water?—O.T., Kan.

A It does sound contradictory, doesn't it? But the breathing paints do shed rainwater effectively and they do permit water vapor to pass without raising or blistering the paint film. The seeming paradox is explained by the fact that the porous paints contain very fine particles of rubber or other synthetic materials. These are sufficiently fine to remain in suspension. When the paint is spread, whether brushed on or sprayed, the particles form a filter-like film having very small openings. These openings are so small that they don't permit rainwater to pass, or leak inward to the siding, even when driven by wind. However, they are of sufficient size to permit water vapor to pass through to the outside. This is the reason that porous paints do not blister or peel. Before applying any of the porous paints be sure to read the special instructions printed on the container.

Q My home has two fireplaces, one on the first floor, the other in the basement. The lower fireplace smokes badly if used when the furnace is operating. What is causing the trouble and what can I do to prevent it?—H.Y., Mich.

A Most modern homes are so tightly constructed that there is practically no leakage of air into the structure when all doors and windows are closed. Your furnace jacket, or shell, is not completely airtight. When the fan is cycling, a small portion of the total output of the fan is drawn from the basement. This must be replaced by air coming down the fireplace flue. As a result, the fireplace smokes because air withdrawn by the fan pulls smoke and gases from the natural fire into the room. Otherwise, the fireplace would operate quite normally. It is possible that opening a basement window

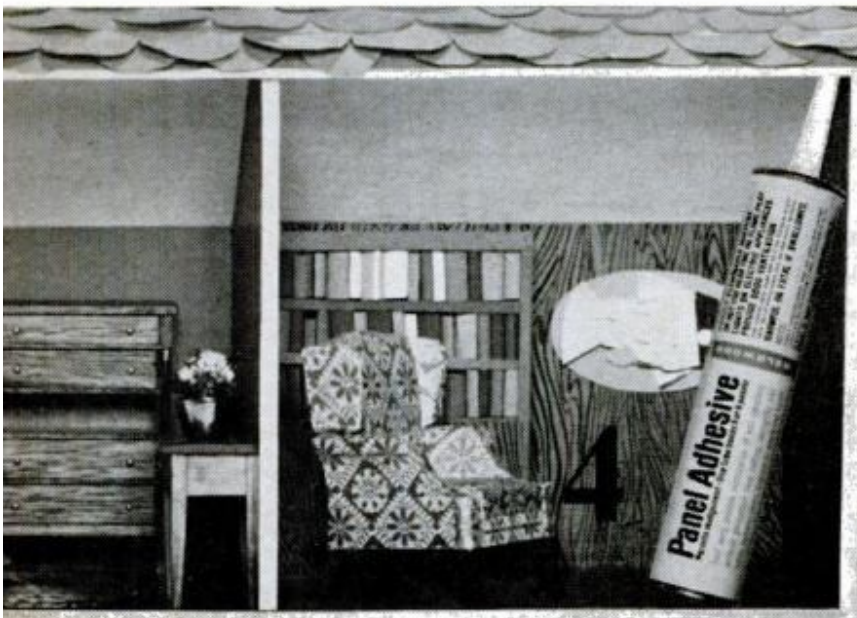
an inch or so would cure the trouble. Although this may not contribute to comfort in your use of the basement room, it is the only simple remedy.

Q My lawn is old and thinning. I haven't given it much care over the past few years. Is it too late to scatter seed? Some of my neighbors tell me that it's too late for fall seeding, others say to reseed only the bare spots and do a general reseeding in early spring. Who's right?—E.G., Ia.

A In your locality it is rather late for fall seeding, but if autumn is prolonged, there is a chance of some success. Judging from your description of the lawn it would seem that it needs an application of a complete plant food especially compounded for lawn grasses. This should be preceded by a thorough spiking to loosen and aerate the soil. It may be possible to rent a spiker from your local hardware dealer. After spiking, rake smooth and apply a fairly heavy seeding to all bare spots, raking the seed into the soil to a depth of about ½ in. Then apply an overall seeding as you spread the plant food, mixing the seed with the fertilizer in the hopper of the spreader. Immediately after spreading the seed and fertilizer, water the lawn and keep it watered to prevent undue drying of the topsoil. If the fall season should be prolonged, there's a good chance that a fairly high percentage of the seeding will catch and attain sufficient growth so that it will winter well. When spring comes, continue the feeding.

Q The brick walls of my home, which is about 50 years old, are badly stained and weathered. I'd like to brighten them up. The mortar seems sound, though of course, it's filled with dirt, I'm thinking of painting, but what kind of paint should I use? And how do I apply it, brush or spray?—L.D., Ia.

A Instead of painting, simply clean the walls. Full spray from a garden hose will wash off a lot of accumulated dirt. If you aid the spraying with a vigorous brushing you probably will get off most of the dirt in the mortar and the stains as well. Stains such as those from a flue, will generally yield to a thorough scrubbing with trisodium phosphate (a tablespoonful to a gallon of water). After applying the cleaner with a scrub brush, hose down the walls and allow them to dry completely; then apply a masonry sealer. This is a clear liquid, applied either brush or spray.



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Take Charge of Your CAREER

By Richard Dunlop

WHAT HAPPENS to the victims when a large corporation decides to slash a wholesale number of employees from the payroll to make way for efficient machines and streamlined methods?

A lot depends on the corporation. Many large companies set up re-training and personnel placement programs. But even when they do, the real burden of re-adjusting rests on the shoulders of the man who has been jostled out of position. Recently, *PM* sent me on a scouting trip to interview industry leaders involved with mass placement problems, and to report their views.

Bernard Haldane is the stubby English-born chairman of New York's Foundation for Re-Employment. Big corporations often retain him to help severed men pick up the pieces of their sundered careers. Haldane and his staff show them how to plan new careers, re-educate themselves and find new jobs. As far as Haldane is concerned, the entire process reflects a swiftly growing trend.

"Nobody can tell today the kind of work he is likely to be doing ten years from now," he told me bluntly. "And Labor Department figures show that more than a third of the jobs today will be obsolete by 1970, or radically changed."

Haldane points out that automated equipment has invaded banks and the insurance industry; that telephone operators have given way to direct dialing; that elevator operators are going the way of hand glass blowers and horse shoers.

Only a few years ago unskilled production workers were in great demand on production lines. Today only a few find job openings. These who do are the ones who planned for it and worked at it. Typical is the husky high school drop-out who stopped me as I walked through the auto repair shops set up under the Manpower Development and Training Act at Chicago's west side Washburne Trade School. He was working in a line of foreign cars swarming with trainees who ranged in age from the 'teens to the fifties.

"I'm back in school," he said. "My oldest brother dropped out of high school five years ago, and he got himself a good job over at International Harvester. He made good dough, and he worked up to machinist. So I dropped out too last year, but I couldn't get a job at all. Everywhere I went, there were jobless kids. That's why I'm back here learning how to be an auto mechanic."

The project director came up. "We graduated the first 116 from the course in June of 1964," he told me. "Eighty-six were placed by the time they graduated because there is a shortage of auto mechanics and body men in the Midwest."

The husky boy had discovered first hand that in a world of new technology a man must have an up-to-date skill to land a job on which he can build his future. I found the same thing true in the blighted coal fields of Appalachia. In South Bend, Indiana, hard-hit by the collapse of Studebaker, it holds true on mechanized farms as well as in automated factories and space age laboratories.

Although experts I talked to differed widely as to the full impact of the new technology on Americans and the jobs they perform, all acknowledged the role of the computer as a primary job destroyer. Not a few suggested: "if you can't beat 'em, join 'em." This is happening too.

One day I visited Oak Park High School in Oak Park, Illinois. This school, which nurtured Ernest Hemingway a couple of generations ago, now is nurturing a group of youngsters who organized a computer club. I asked mathematics teacher Norman Thompson how it started.

"Dr. Peter Lykos, director of the computer center at Illinois Institute of Technology, gave a talk here," he explained. "The kids were so intrigued that they asked me to be the faculty adviser to a computer club. They accepted Dr. Lykos' invitation to visit the computer center at IIT. Each youngster programmed the Univac 1105. They proved that kids can do it. Now *we* have a computer class too."

The classroom in which Thompson meets with his class has the usual rows of seats, and blackboards cluttered with math problems. There is a brace of Minivac 601 machines in the rear. I asked one of the students if he found programming difficult.

"It's far more logical than math," he said, "and it's fun. I can do my programming work in study hall."

Later I visited Dr. Lykos at the IIT computer center. He had come back from his lecture at Oak Park High as excited as the kids. Soon afterwards IIT sent letters to some 200 Chicago area high schools, inviting them to send bright students to the center for a high school

(Please turn to page 32)

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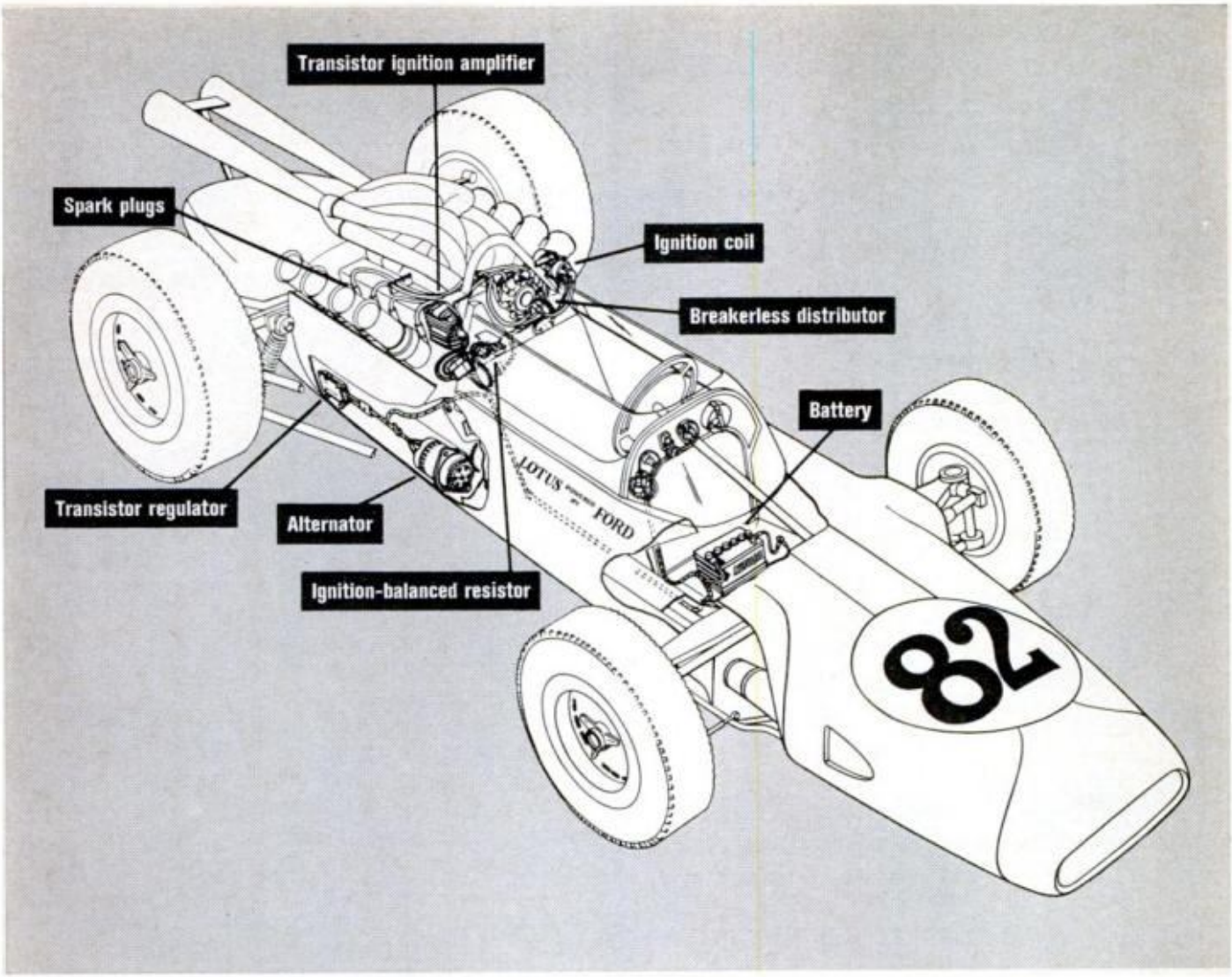

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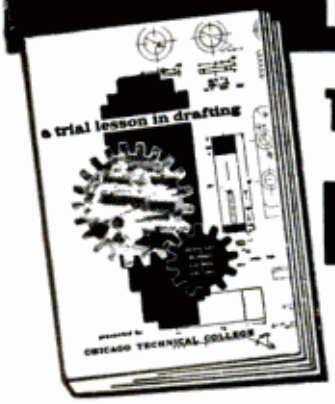

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Take Charge of Your Career

(Continued from page 30)

basic course in computer programming.

"Two inexperienced youngsters walked in one day," Dr. Lykos related, "and in 15 minutes they had come up with a better way to program the computer than the IBM experts had written," he said.

This spring IIT had 720 high school students running programs on the 1.5 million-dollar computer.

"The basic language of a computer," explains Charles Bauer, director of secondary school computer science education at the IIT center, "is similar to high school algebra. Within 16 hours we can have any intelligent person running his own program. It takes a lot of the mystery out of computers. They're not flashing monsters; they're machines that can do for you a lot faster only what you could do for yourself."

Peter Lykos adds significantly: "If the kids can make their peace with automation, so can grown-ups."

In South Bend, home of the venerable Studebaker Corporation, I found that kids and grown-ups both were making peace with a situation far more stark than a mere lowering threat of automation. Eight thousand families in this industrial community of 130,000 people had earned their livelihood at the century-old Studebaker plant. On December 9, 1963, the hard-pressed company closed its sprawling, antique buildings to concetrate its efforts in more modern facilities at Hamilton, Ontario. Economists said that the shock wave of unemployment touched off by the shut-down would race through South Bend. It would become a ghost town.

I found South Bend far from ready to give up. Shoppers crowded downtown Michigan Avenue. Stores were putting the rubble of a building, leveled to make way for a new structure. What had happened?

During the not-so-merry Christmas of 1963, labor, business, city, state and federal government and volunteer agencies joined forces to find a way out of the crisis. Project ABLE, which stands for "Action Based on Long Experience," was organized to avert economic disaster.

First order of business was to get 3556 former Studebaker workers aged 50 and over back to work. A man who had been machining ball bearings all his life found out that his level of skill was not sufficient to win him a job in one of the new parts firms which South Bend business leaders were bringing into the community. A man working for decades on production lines had even worse prospects.

(Please turn to page 34)

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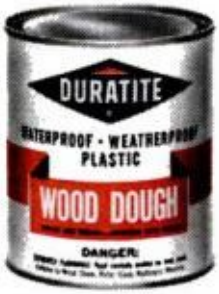

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BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY DU PONT

Take Charge of Your Career

(Continued from page 32)

Project ABLE's all-out campaign called for a crash program of re-education. At the Studebaker plant I found that machinery bought by the government from the Brooklyn Navy Yard had been trundled over the brick floorings and set up to help the men learn new trades. Former workers of all ages were studying everything from air conditioning to shoe repair.

"At first we followed vocational high school methods," said Owen Stine, the school's director, "but now we are more practical. Our auto body repair trainees work on cars right off the street; the refrigerators our men work on are being fixed up for the Boy Scout camp."

Local firms asked that training be given some men to fill particular slots. One shop needed welders to work titanium, so titanium welding was added to the course.

At the fledgling Aerospace Company's machine shop precision parts were being made in a neat little brick and concrete plant close by the deserted wreck of the old Oliver Company foundry. Aerospace employs several former Studebaker machinists, who are being given on-the-job retraining. I found them making firing pins for rockets, working diligently with complex, precision tools. They and most of the other people in plants and shops throughout the city had accepted the challenge of new technology by learning to use new automated machines.

Oddly enough, statistics already are proving that in communities with fully modern, automation-efficient industries, unemployment rates are far lower than in areas with industries that thump and rumble with machinery of the past.

How can you proof yourself against job anxiety in this time of explosive change? In future issues of *PM*, this column will tell you where and how a man can re-educate himself in a wide assortment of job categories. It will also provide up-to-date information on where many skilled and semi-skilled services are in demand throughout the country. ★★★

Globe Trotters' Note: The United States is sponsoring an exhibition of hand tools to be shown in Russia this fall and winter.

To explain the tools and their uses to Soviet audiences, the U.S.I.A. is recruiting guides—Russian-speaking American citizens (21 years or older) with a knowledge of tools. Applicants should contact: United States Information Agency; Washington, D.C. 20547; Attn.: IPT/D—Mr. Flynn.

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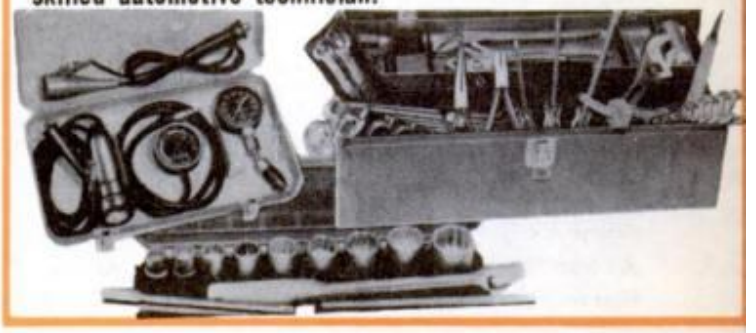

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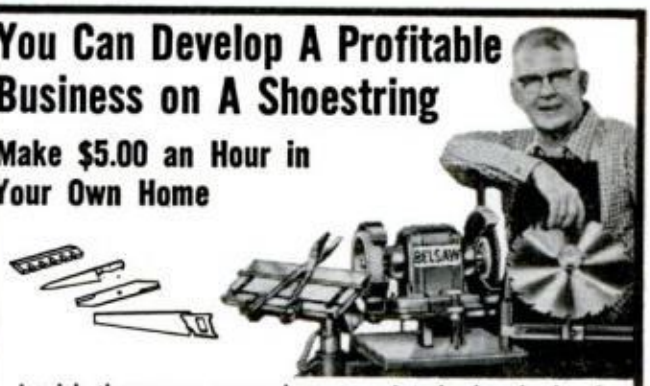

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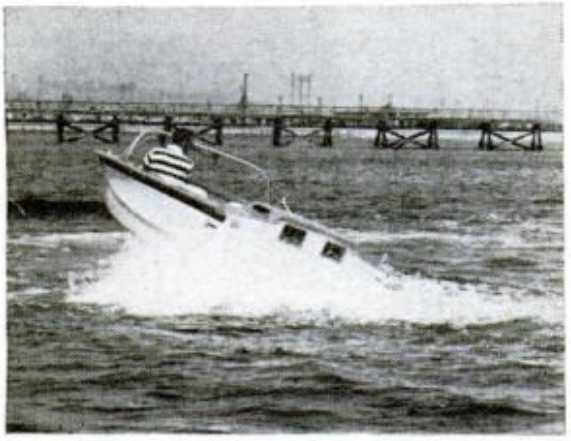
Spotlight on the Wayne 100



By Pat Parrett

IN THE BOATING FIELD, radical engineering developments are extremely rare, so it's exciting when something really new and different comes along. Well, Wayne Horning's air-cooled inboard, "Wayne 100," is packed with enough new design concepts to satisfy anyone, and I couldn't wait to take it out on a test run.

Checking it over on the trailer, I noted that the hull itself isn't a new design—it's a 16-foot Glasspar Avalon—but the bottom end of the propulsion system is an instant giveaway that this is no standard inboard. Instead of struts and a shaft, I found what looked like an outboard lower unit mounted on the bottom of the boat.

Climbing into the cockpit, I swung back the cover on the sealed engine compartment and discovered an air-cooled engine mounted vertically. The drive shaft extended straight down through the hull to that lower unit. Horning explained that the angle of the engine and drive assembly can be adjusted about the bottom opening in the hull for optimum inclination of the propeller in relation to the boat. And that prop house beneath the hull is rotatable.

Still on land, I fired up the engine and let it warm to operating temperature—an unnerving experience for anyone who is used to running a regular water-cooled inboard. There was no need to push the boat off the trailer during launching. I simply shifted into reverse before reaching the water, and when the prop hit water the boat pulled itself gently off the trailer skids.

I made the first straightaway run through a light chop with the throttle wide open. There was no torque to fight, and even at full rpm the boat held its course so well that I could take my hands off the wheel.

Steering through Horning's patented hydraulic power system is completely positive, with almost instant response. It's also failsafe inasmuch as over-riding manual control is always available.

Starting the second run from a standstill, I found that the engine has a lot of pulling power at the low end. Its high torque at low rpm should make this rig especially suitable for pulling skiers from a deep-water start.

Checking out the top speed, I pushed it up to 44 mph at 4700 rpm in a light chop with one passenger aboard. The prop was a 12½ by 17 standard Michigan model.

Still running flat out, I threw the boat into tight left and right turns without experiencing any breakaway or cavitation. The engine and boat responded quickly to all controls.

Incidentally, our test craft was equipped with adjustable trim tabs which are standard equipment on all Wayne 100-Avalon models. These tabs increase lifting power at the stern and can be adjusted to obtain the best possible planing angle with any load distribution.

Horning, well-known in automotive circles for his 12-port cylinder head designs for Chevy and GMC Sixes, spent six years developing and testing the engine,

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An air-cooled engine sealed up in a pressurized box, a lower unit *under* the hull—it's all way-out engineering, and it works

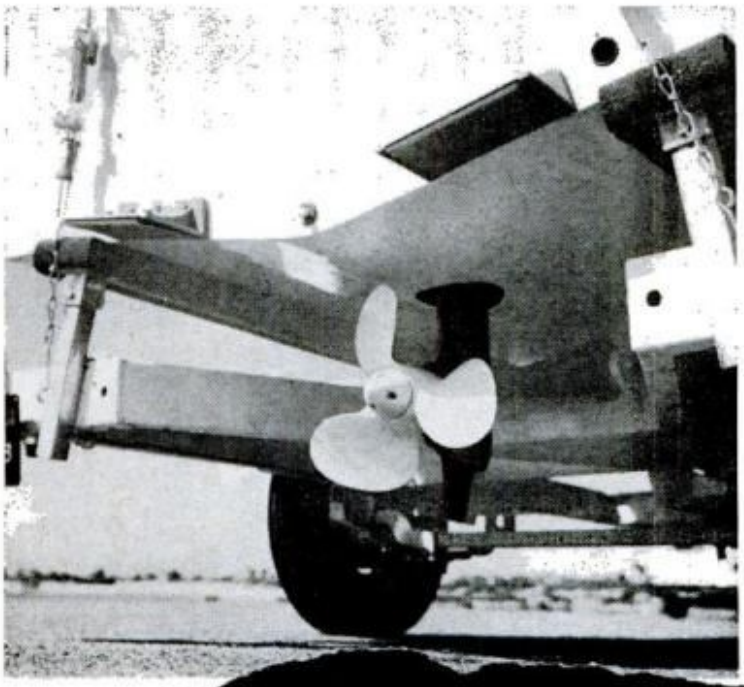
propulsion and steering systems. He holds patents covering all of these and is president of Inboard Marine, Inc., Temple City, Calif., the manufacturer.

The engine is manufactured using Corvair components purchased from Chevrolet. The secret of its successful adaptation to marine use is the invention of a practical system of cooling in which the engine sits in a sealed, pressurized compartment.

A fan on top of the engine forces air through the compartment at the rate of 2000 cubic feet per minute, expelling it with the engine exhaust through ports on the transom. In addition to cooling the engine, the fan cools and insulates the exhaust system and provides fresh air to the carburetor.

The designer overcame several problems which have slowed development of air-cooled engines for marine use. Instead of enclosing portions of the engine with cooling ducts, he enclosed the whole engine in a pressurized compartment, so once the compartment is open, the engine is completely accessible for servicing and repairs. Also, this set-up doesn't interfere with angular adjustments of the engine for different degrees of engine-shaft inclination.

(Please turn to page 40)



POWER STEERING, right in the middle of planing platform, is result of Horning's unique system of delivering power to the prop. That stubby lower unit protruding through the bottom of the boat is fully rotatable, just like the lower unit of a stern drive, so steering is much quicker and more positive than in a conventional rudder steering system. Note the transom trim tabs, standard equipment on all Wayne 100 models, which allow you to achieve the best possible trim, no matter what the load distribution in the cockpit

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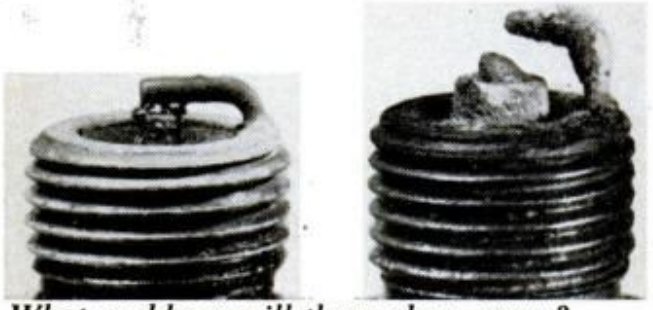
Test your automotive I.Q.



What problems will these plugs cause?

What does this symbol stand for?

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Spotlight on the Wayne 100

(Continued from page 39)

If water happens to enter the intake ducts it can't possibly flood the cooling system because the high-speed fan will atomize it into a fine mist which will be expelled through the exhaust ports.

Naturally, one major advantage of an air-cooled marine engine is that you can forget about corrosion—no flushing out the cooling system when the boat is removed from salt water.

Horning equates performance of the 95-hp rig we tested with that of a 100-hp outboard or a 120-hp inboard-outdrive. This, he says, is due to several factors, including primarily the highly efficient power transfer from crank to propeller.

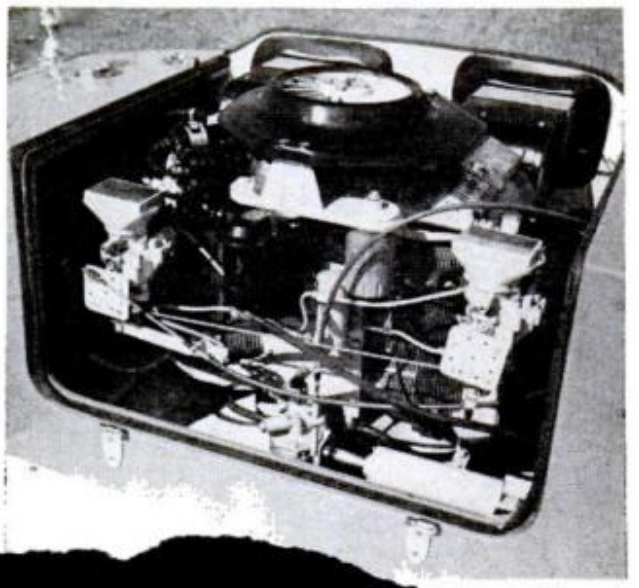
The Wayne 100 offers a low weight-to-horsepower ratio, and close to net horsepower on prop. The total weight of the complete propulsion system installed, including engine, drive and propeller, without a battery or fuel tank, is approximately 350 pounds.

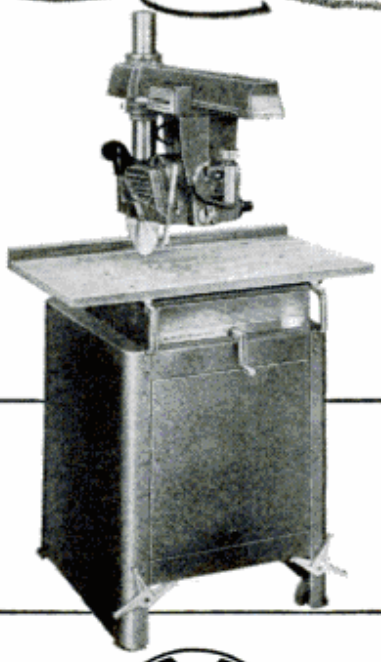
A unique optional extra is a built-in heating system for the cockpit. By tapping into the cooling shrouds with three-inch flexible tubing which runs up forward under the foredeck, you can enjoy shirt-sleeve boating into late fall. Warm air flow is controlled by a valve.

Although designed for installation in any standard inboard hull, the Wayne 100 package is initially offered by Inboard Marine only in the Glasspar Avalon.

The purchase price of less than $3000 includes the boat on a trailer, fueled and ready for the water, plus a year's factory service and warranty. ★ ★ ★

PRESSURIZED ENGINE COMPARTMENT cooled by the fan on top of the engine is one of Horning's most interesting innovations. It has through-transom exhaust





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Only Sawsmith lets you dial the correct speed for every operation with exclusive Vari-Speed Drive. Sawsmith cross cuts, rip cuts, miters, bevels, dados, rabbets, routs, molds, shapes, grinds, drills, sands... performs almost any woodworking job. Buy Sawsmith... the world's most versatile radial arm shop!

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The technical improvements that save you money are: positive seals to prevent leaking dirty air and "Arch Pleats" for greater efficiency, more mileage and greater savings on gasoline. "Arch Pleats" are important where the pleats of ordinary filters pinch together and impede the flow of air halfway down the fold, the "Arch Pleat" does not collapse. Thus, you get a bonus in extra value and substantially greater mileage.

Ask your service man for WIX Polymite Air Filters. Don't let him kid you about all Air Filters being the same. If he doesn't have WIX, call up a local WIX jobber...he'll tell you where you can get them.

WIX® FILTERS

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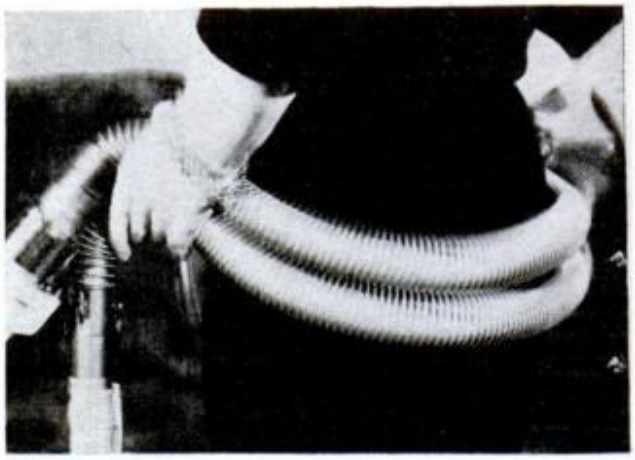
Whether in quest of therapy or pleasure, men and women for centuries have sought the services of the professional masseur—or masseuse. Now, at substantially reduced cost, similar enjoyment may

VACUUM CLEANER replaces masseur when the Pul-Vac attachment is added. Air vents control vibration



VIBRATING AIR BELT wrapped around the body simulates massage by a thousand busy human fingers

be gotten from—of all things—a vacuum cleaner.

A specially developed valve called "Pul-Vac" is attached to a seven-foot flexible tube, which in turn is attached to the hose of any tank vacuum cleaner. A pulsating air flow vibrates at the rate of 1800 cycles per minute along the entire length of the hose. Cost: $19.95. Made by Pul-Vac Inc., 1403 E. 180th St., Bronx, N.Y. 10460.

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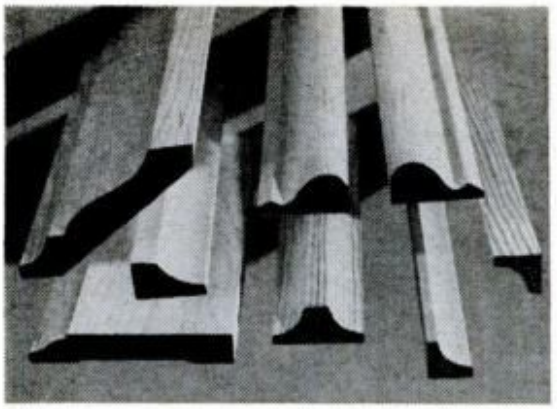

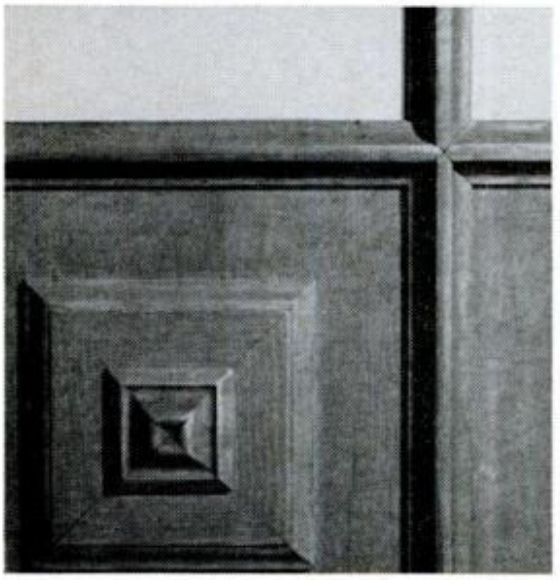

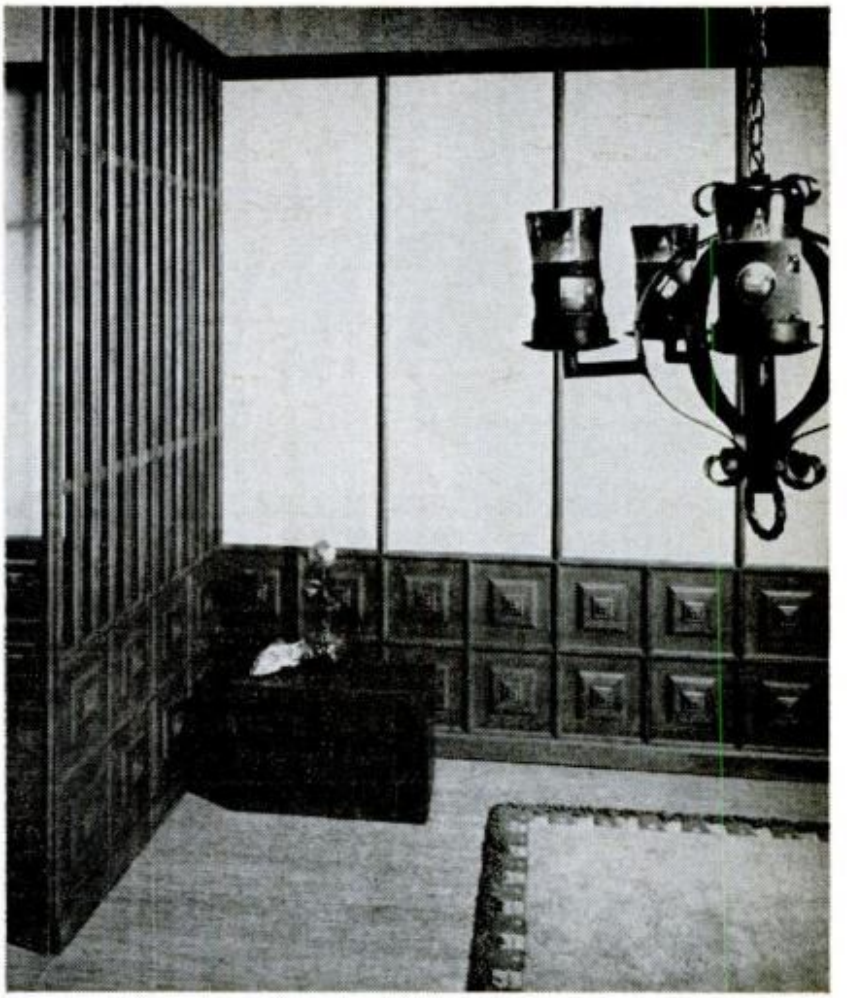

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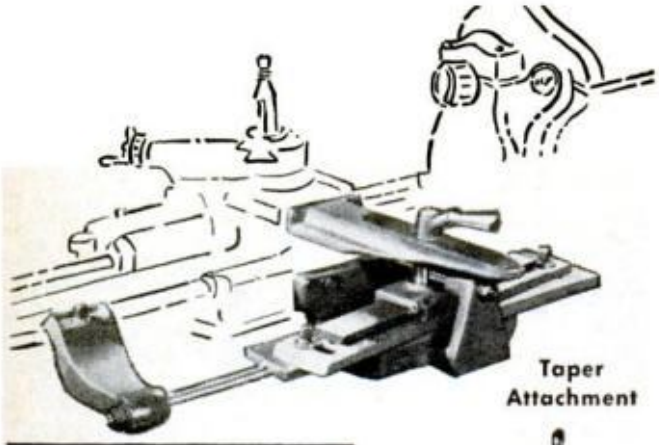
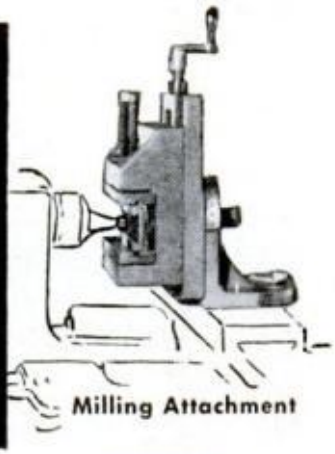


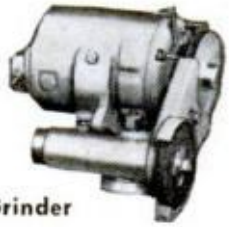
Taper Attachment

Get More Work out of Your Lathe



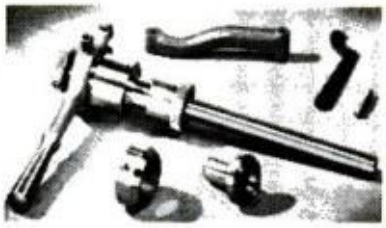
Milling Attachment

Steady Rest



External Grinder

Live Centers



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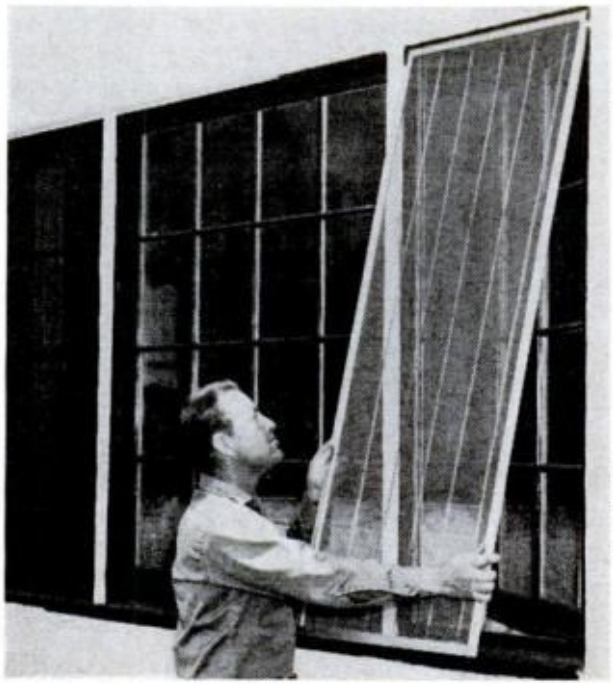
Hang those empty jars: Handy Dandy plastic caps are made specifically for empty baby food jars. They have prongs for insertion in ⅛-in. pegboard, making it literally a snap to store cotter pins, screws and the like. Retail price is $1 a dozen, $2.50 for 3 dozen. From Wickliffe Industries, Inc. Wickliffe, Ohio

Screen out burglars: Dual-purpose window screens have burglar-alarm wiring woven into the fiberglass mesh. When installed, these wires are connected to an alarm that goes off if the screen is cut or pulled away from the window. Priced at $1 per sq. ft. and up. Imperial Screen Co., 13892 S. Western Ave., Gardena, Calif.



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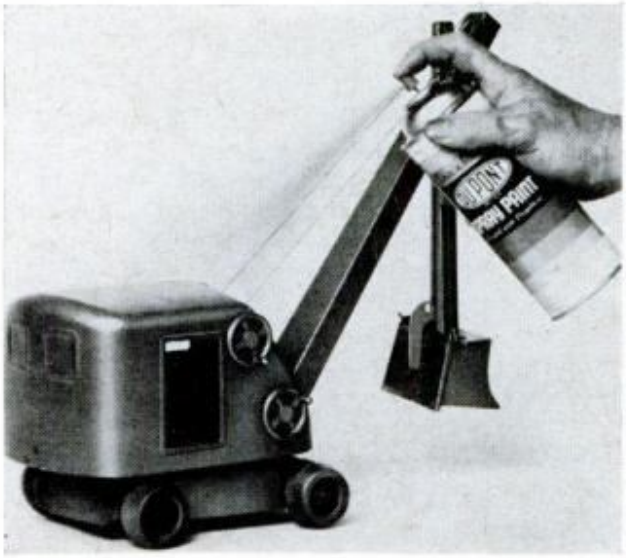
Market



Make fast work of spray-painting jobs with Spray Paint, a lacquer-enamel formulation that dries within minutes of application. Available in 13 colors, including copper, gold, silver, flat white, gloss white. Spray valve is said to be clog-free. Retails for about $1 and up. Manufactured by the Du Pont Co., Wilmington, Del.

Ceiling goes on like a bandage: You just peel the paper backing from each 12x12-in. Con-Tact Brand acoustical tile, press the tile into place and it stays put. No furring strips or hangers. Ceiling must be clean and dry for adhesive tabs to work properly. Cost 29 cents a tile. Cohn-Hall-Marx Co., 1407 Broadway, New York, N.Y.

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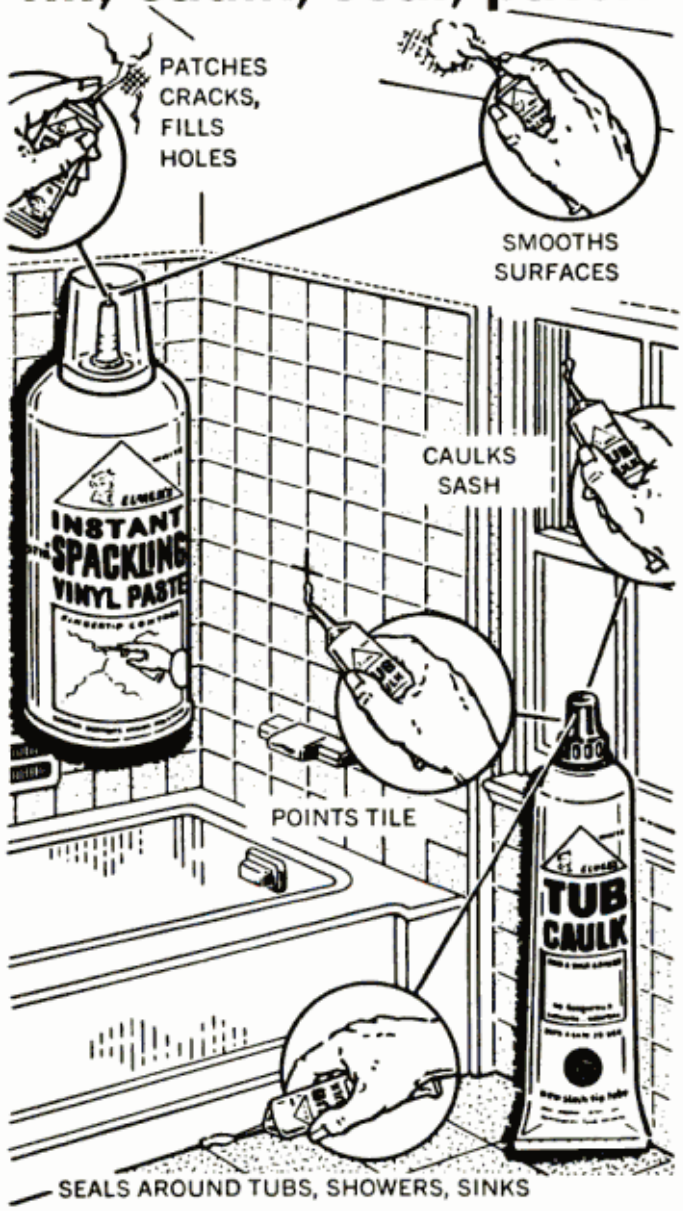

Elmer's Instant Spackling Paste is a ready-to-use compound that puts an end to wasteful and messy mixing. Just press the stem of the aerosol container for the right amount to fill holes, cracks and low spots in plaster, wood or composition walls before painting. Dries in minutes and sands to a feather edge.

Elmer's Tub Caulk is an elastic sealer, ideal for waterproofing jobs in kitchen, laundry and bath. The handy squeeze tube delivers a satin-white bead that won't discolor or crumble. Simply remove excess with water, no solvents needed. Safe for any surface, nontoxic and odorless. The Borden Chemical Company, 350 Madison Ave., N.Y., N.Y. 10017 (Available in Canada.)

BORDEN CHEMICAL

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Noteworthy New INVENTIONS

By M. J. Pedersen

An airborne platform that can run on the ground or fly troops or supplies over rough terrain earned patent 3,184,183 for Frank N. Piasecki, head of Piasecki Aircraft Corporation. Nicknamed the "Aerial Jeep" by the Army, the raftlike vehicle has two ducted fans, one in front and one in back of the pilot, which are set into the platform itself and operate like helicopter blades to provide vertical lift. Highly maneuverable both in the air and on land (by virtue of its powered wheels), the vehicle could also serve as a firing platform.

Fire-fighting angel, perched atop a Christmas tree, has an automatic sprinkler system for dousing the branches when the tree temperature gets too high; it received patent 3,171,493 for Brian W. Barr, Stoney Creek, Ontario.

New inventions and products from around the world will be displayed at the *International Inventors and New Products Exhibition* which will be held at the New York Coliseum between September 9th and 12th. Sponsoring it is the International Institute for Patented Products, Ltd., with New York headquarters at 554 Fifth Ave.

"Open Sesame" did the trick for Ali Baba in the past, and the same magic words—or a similar code—may do it again. The modern home or car owner may some day gain entrance simply by ordering the door to open, using a voice-operated lock that won patent 3,184,937 for Dr. Irving H. Sher of Philadelphia. A simple device called a "Sceptron" analyzes the spoken sounds, since the lock is designed to unlock to a specific command spoken by a specific person—or persons. Highly exacting, this system also has military possibilities for guarding secret documents.

Boat-in-a-suitcase enables an angler to store his fishing equipment in a boat, then fold up the boat for easy carrying to the lake. Made of lightweight aluminum, the combination collapsible boat and carrying case earned patent 3,184,768 for John E. Thomson, Pittsburgh, Pa.

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For your SMALLER Jobs:

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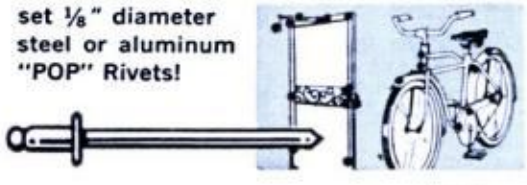

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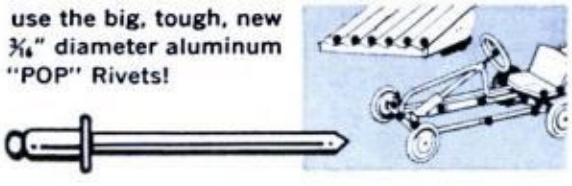

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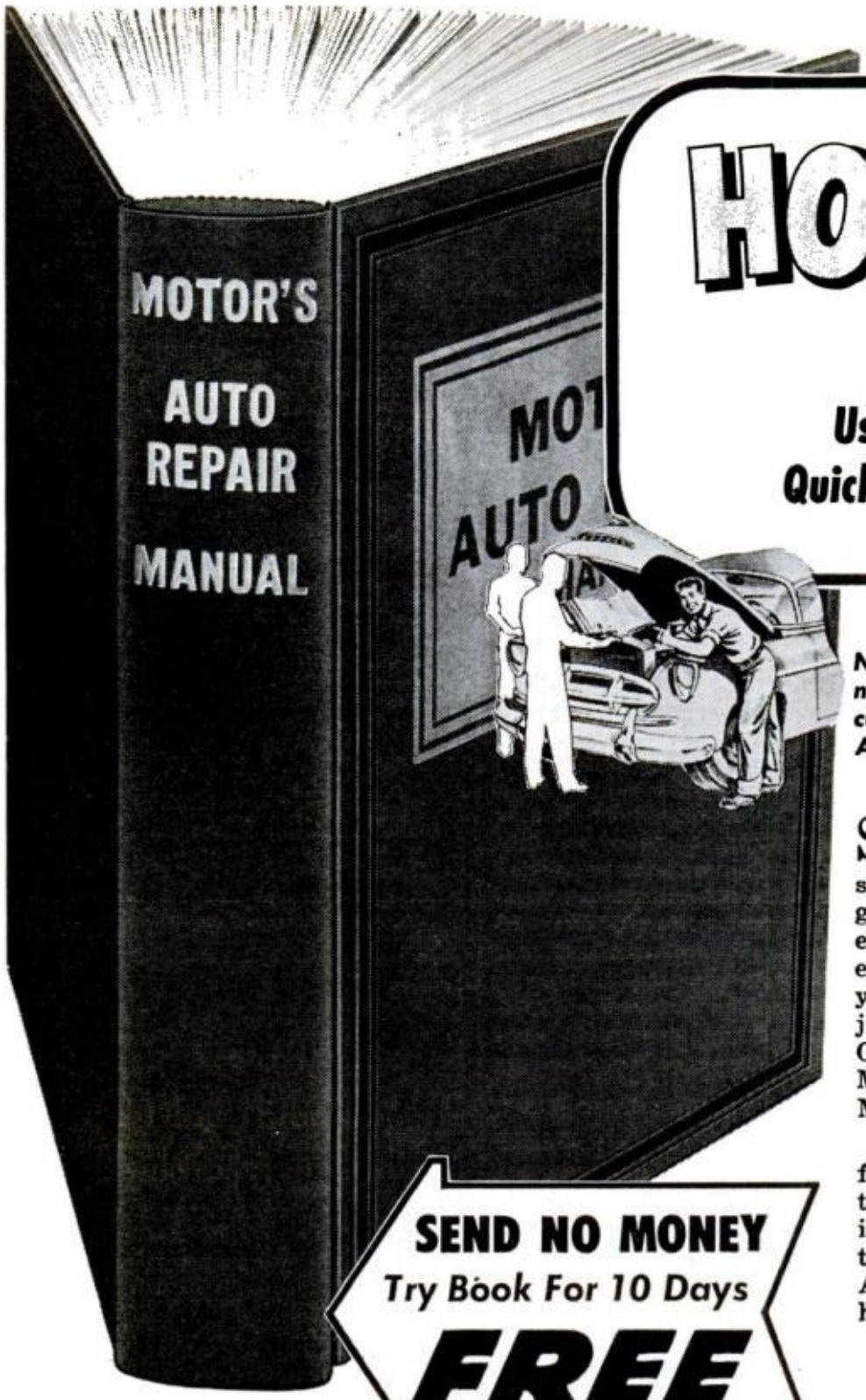

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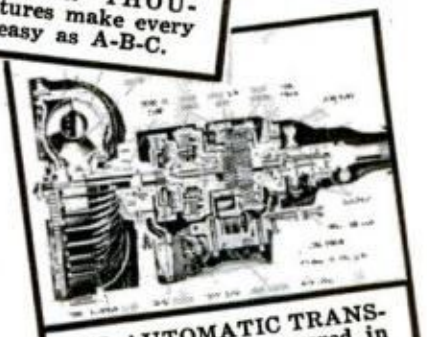

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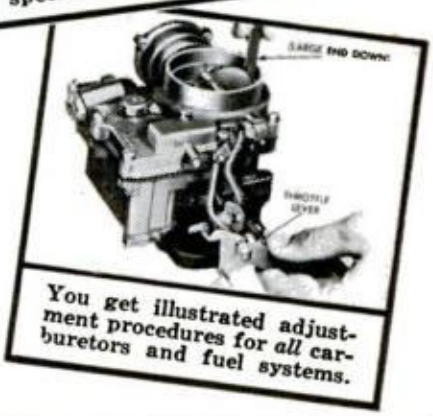

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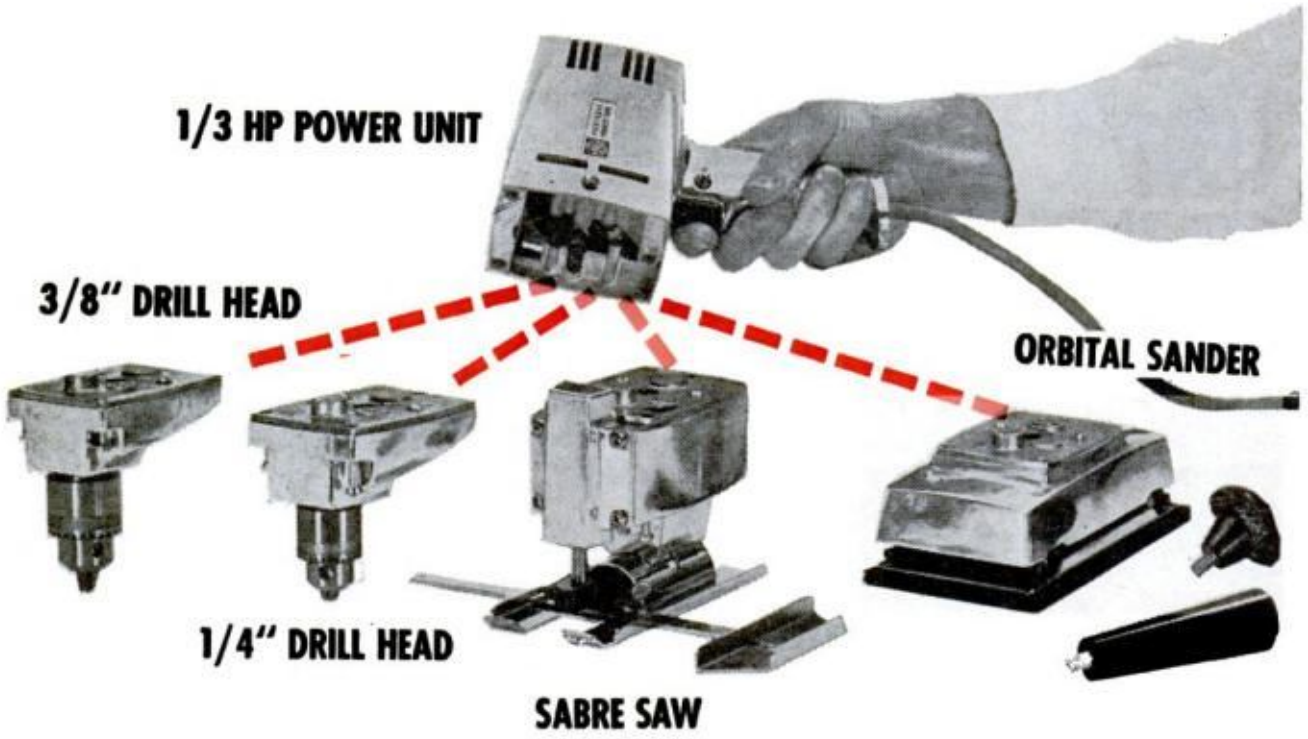
PM Tests GE's New

4-in-1 Portable Tool



IDEA LOOK FAMILIAR? Look again: that ⅓-hp powerhouse couples to any one of the four gear heads to create a completely separate tool. Those heads aren't *accessories* that attach to a drill spindle; they're individually-geared tools, powered directly from the motor shaft of the handle unit. Each head is engineered for its specific job. The result: all the economy and compactness of an accessory system, without any compromise in performance.

You can acquire the set in several ways. Say you own no power tools, now, and your upcoming project calls for a standard drill. You buy the complete ¼-in. drill for under $19. Its 1800 rpm is fine for high-speed drilling of wood and plastics. But for your next job you need *low* speed and high torque, to drill into masonry or metal, or to power a wire brush, grinder or polisher. You buy the 900-rpm ⅜-in. head for $10. Later, you want a finish sander, and add that head. And finally you complete the set with the sabre saw. Each of these is $13.98, suggested retail price. With the last three heads you get an extra handle, which screws into any one of three sockets in the power unit.

Buy Any Tool First

You can, of course, start with any of the complete tools (the sabre saw or sander is under $28 with a power unit) and add only the heads you need.

Already own a ¼-in. drill? Then the in-a-case shop is for you: it includes the other three heads, plus assortments of drills, sandpaper and blades. Complete with the power unit, it's priced under $55. You can hang the case on the wall, then tote it to the job. To round out the line, GE is also offering a 7-in. circular saw

(Please turn to page 52)

YOUR PORTABLE WORKSHOP. The power unit, plus drill head, sander head, sabre-saw head and accessories, stash away in this metal hang-or-tote case

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MORE NEWS FROM HONDA—

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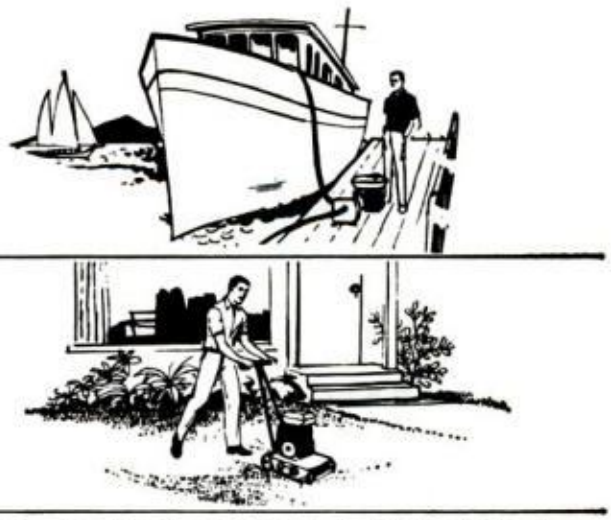

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PM Tests GE's New 4-in-1 Portable Tool

(Continued from page 50)

with its own 1⅓-hp motor; it's priced at $37.98. The whole family of tools will be in national distribution next month. All tools come with a standard three-prong grounding plug.

After testing the tools, we can report that GE hasn't put all its money on the interchangeable gimmick. Each tool has a good, solid heft, with a performance comparable to any medium-weight, one-piece equivalent. Particularly impressive is the sabre saw, which delivers 3300 ⅝-in. strokes per minute, and incorporates several features new to us. The chuck will take any standard ¼-in.-shank blade—even one with the neck broken off—and is offset ahead of the shaft to provide a clear view of the cutting line. There's a blower to keep the line clear of sawdust, and a rip guide that flips over to double as a circle-cutting jig. The saw's three-position table lets you start edge cuts, make right or left bevel cuts, or run the blade right up to a wall. Best of all is the cross-slotted chuck that lets you mount the blade sideways for running a flush cut along a wall or for high-reach cutting where it would be awkward to hold the saw in the usual blade-trailing position. The 2-lb. sander head delivers 4000 3/16-in.-dia. orbits per minute. It's designed for minimum vibration, takes exactly ⅓ sheet of paper, and allows flush sanding and feather-edging.

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The gutsy power unit is up to all its jobs. Inside the die-cast aluminum housing, its heavy-duty motor runs in two bronze bearings and boasts tough windings, an oversize cooling fan, and shunted brushes for heavy amp loads. The motor's rated at 3 amps at 120 volts, AC only. The trigger switch has a thumb-button lock to free both hands for maneuvering.

Without long-period testing, we can't evaluate durability, but the housings are well-designed and sturdy. Verdict? If you've already got a full line of portable tools, GE's entry into the field doesn't render yours obsolete. But if you're just starting a set, the line's worth a look.

—Alfred W. Lees

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Rolls Royce Reflex

LONG AWAITED, the Leicaflex for years was the subject of rumors and speculation. Now it's here. Recently, it was in my hands for a three week test.

At first, the camera seemed heavy and awkward compared to other SLRs. But after running a couple of rolls through, it became apparent that the camera's heft had a decided steadying effect that practically guaranteed shake-free pictures. Also helping to beat the shakes, by the way, is a unique cam lever arrangement that gently stops the upward movement of the mirror, eliminating the vibration that is a bugaboo in many other cameras

(Please turn to page 56)

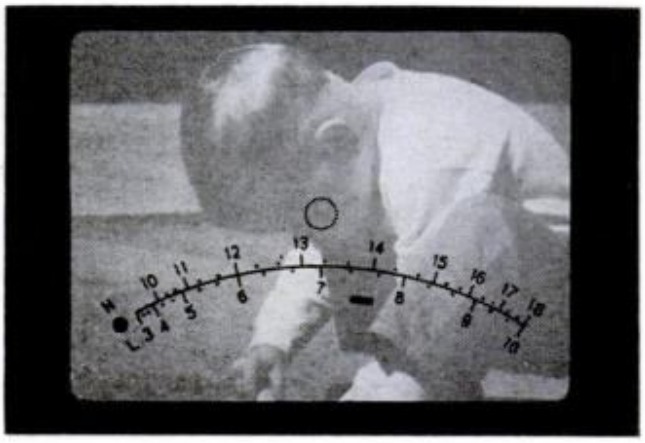
SET EXPOSURE by turning shutter speed dial or aperture ring to superimpose pointers. Viewfinder center spot indicates when lens is in focus

Pinpoint Meter

HERE'S A METER that zeroes in on a tiny area to give ultra-precise exposure readings even when camera-to-subject distances are great. A single lens reflex optical system is used in the Honeywell 1/21 spot meter that makes it possible to read light intensity in a 1° angle of view. At ten feet, for example, you can meter an area the size of a 50¢ piece.

In testing, the 1/21 proved it could handle even the most nightmarish exposure problem—taking accurate long range readings of backlit subjects.

The meter, priced at $129.50, is distributed by Honeywell Inc., 4800 E. Dry Creek Rd., Denver, Colo.



LOOK THROUGH this new CdS meter and you see separate scales for taking readings in bright or dim light. Tiny circle shows area being read

By Bob Berger

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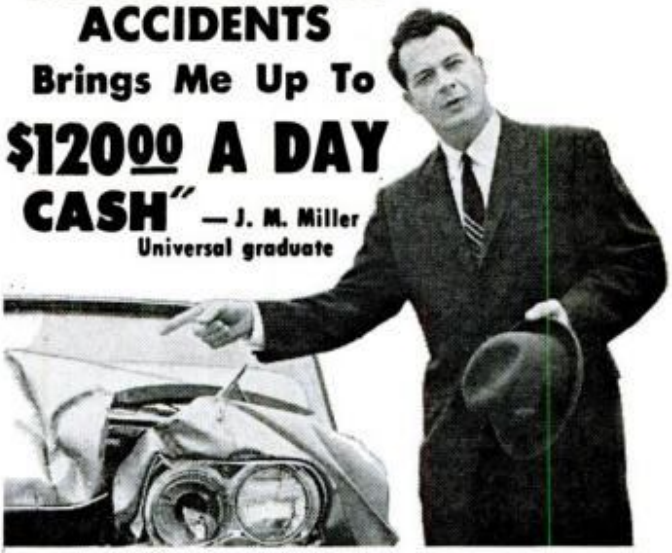

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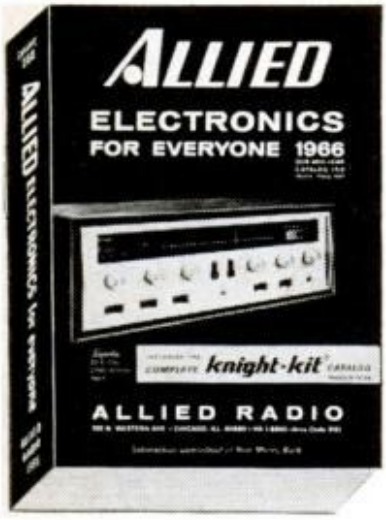

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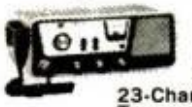
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Rolls Royce Reflex

(Continued from page 54)

of this type.

The viewfinder is a mixed blessing. It provides an amazingly bright image but because only the center of the finder is used for focusing, it is impossible to check depth of field through the lens. For many photographers, the brilliant viewing and rapid, pinpoint focusing will more than make up for the lack of depth of field previewing. But a choice of viewing screens would have been highly desirable.

What about the optics? Leitz lenses made for their rangefinder cameras have always been considered as a sort of standard for the industry. The ones manufactured for the Leicaflex are no exception.

The built-in CdS light meter reads an area roughly equivalent to that covered by a 90-mm lens. Though the meter does not read through the lens as on some other SLRs, every one of the test shots was accurately exposed, even in tricky light.

SLR cameras tend to be a noisy lot. The combination of flipping mirror and sliding focal plane shutter results in a clunk and clatter that often unnerves the candid cameraman. Not so with the Leicaflex—its shutter and mirror are remarkably quiet.

A number of refinements are worth noting. There's a special lock that prevents accidental opening of the camera's hinged back. Even the rewind button boasts some thoughtful engineering. Once depressed. it stays down by itself while you rewind. An especially convenient feature is the shutter speed scale visible just below the viewfinder image. When you turn the shutter control, a pointer moves along the scale to indicate the speed. Speaking of shutters, the Leicaflex has a sizzling top speed of 1/2000 sec.

Most manufacturers of SLR cameras offer what they term "a system of photography"—a complete line of lenses and accessories that make it possible to handle almost any photographic situation. At present, the buyer of a Leicaflex has no such "system" available. In fact, only four lenses (35, 50, 90, 135-mm) are obtainable. Undoubtedly, more lenses and accessories will be offered in the future. But in view of the almost legendary Leitz conservatism, it may be a long time before the equipment list grows significantly.

It should come as no surprise that the Leicaflex doesn't carry a budget price tag. Equipped with 50-mm F:2 Summicron lens, it sells for $549. The distributor is E. Leitz Inc., 468 Park Ave. So., New York, N.Y

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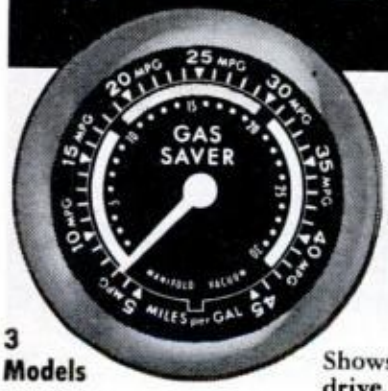

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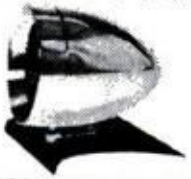

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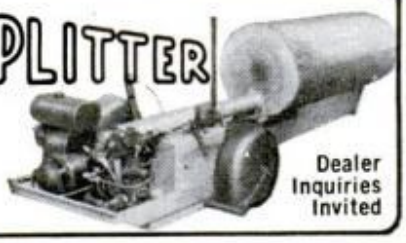

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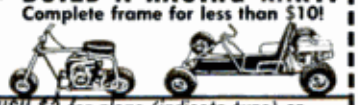

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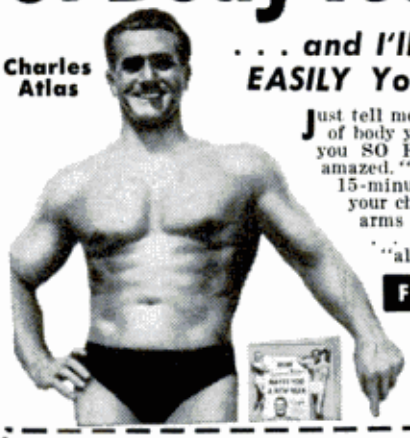

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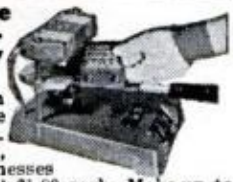

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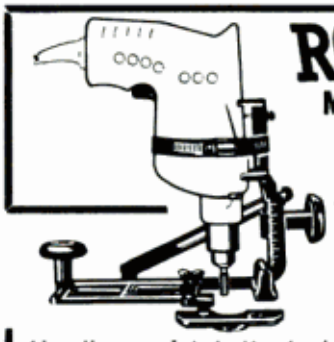

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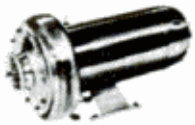

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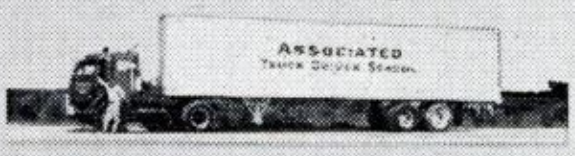

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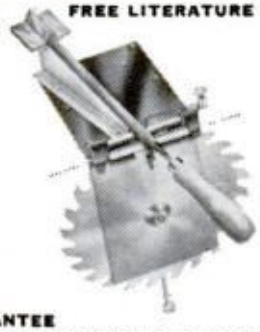

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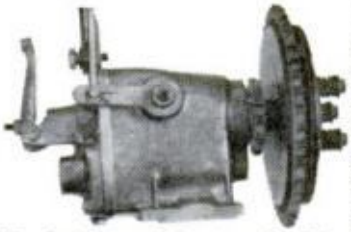

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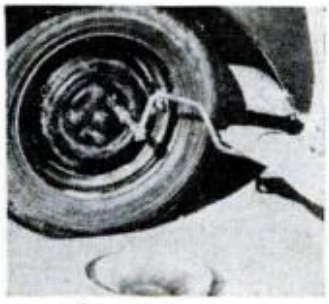

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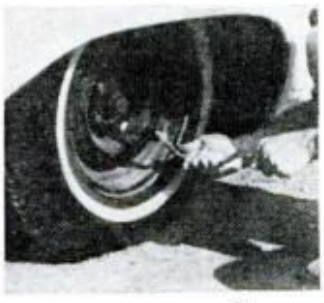

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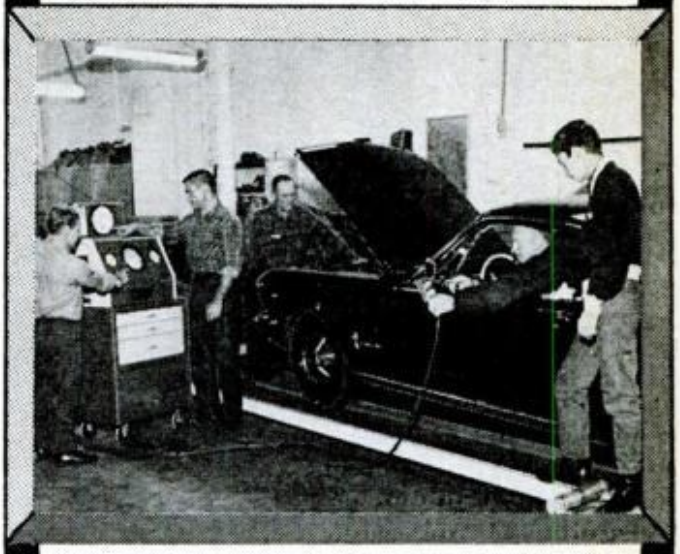

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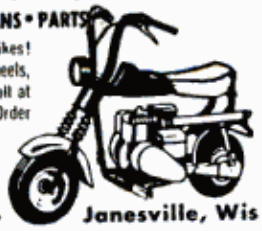

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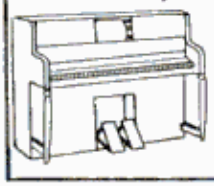

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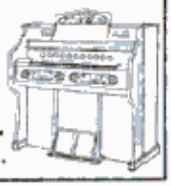

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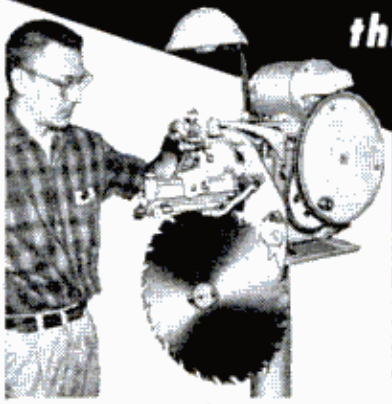

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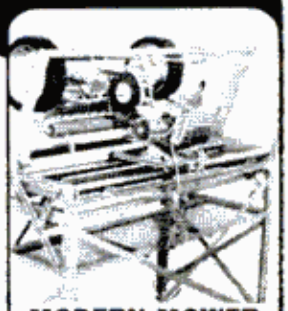

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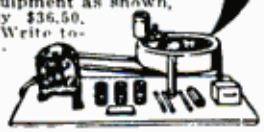

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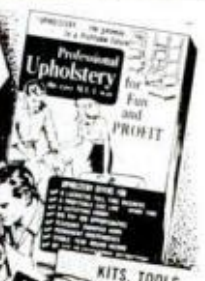

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BAKE New greaseless doughnuts in kitchen. Stores buy output. Start spare time. Profit 29¢ dozen. Small appliance. Free recipes. Montgomery, 3605 South 15th, Minneapolis 7, Minnesota.

PROFITABLE Mail order business. Be independent. Details free. Ideal, Box 357-EE, Valley Stream, N.Y.

FREE "Franchise Profit Letter" tells how unique NFR service is helping thousands seeking profitable businesses. Write today. National Franchise Reports, W-528, 333 North Michigan, Chicago 1.

SECRETS! Secrets! Mail order success revealed by internationally famous expert who discovered how to make home business fortunes. Beginners: Get free copy "How to Make Money in Mail Order." Discloses free advertising, profitable products, everything! No obligation. Write Mailco, 1554 Sepulveda, Dept. P-709, Los Angeles 25.

PACKAGE At home for profit! We supply everything. No "selling." Free home business details. HPC, 807HPM Sunset, Los Angeles 12.

FREE Facts and descriptive bulletin. Be an air conditioning, refrigeration, and heating serviceman. High pay, jobs open everywhere, operate your own service business, no school or correspondence necessary. Write Doolco, Trouble Shooter, 2016 Canton, Dallas, Texas.

$70.00 WEEKLY—home, spare time. Simplified mail bookkeeping. Immediate income, easy. Auditax, 34741a, Los Angeles 34.

MAKE $46 From square foot plywood: jigsaw necessary. Free details. Woodart, Bridgewater, Mass.

EARN Money raising fishworms for us! Write: Oakhaven-38, Cedar Hill, Texas.

IMPORT-Export opportunity, profitable world-wide, mailorder business from home, without capital; or travel abroad. We ship proven plan, for no risk examination. Experience unnecessary. Free details. Mellinger, P709, Los Angeles 90025.

MAKE $32 From 49¢ piece vinyl. PMA-1834 Edgeland, Louisville, Ky. 40204.

PIANO Tuning learned quickly at home. Tremendous field! Musical knowledge unnecessary. Information free. Empire School of Piano Tuning, Box 327, Shenandoah Station, Miami, Florida 33145. (Founded 1935).

400,000 BARGAINS below wholesale! Many free. Liquidations, job lots, single samples. Free details. Bargainhunters Opportunities, Box 730-A, Holland, Michigan.

MAKE Money from old tires. Operators clearing $400 weekly. Equipment costs $800. Get facts. S & S Patents, Inc., 3511 N. Lincoln, Chicago 13.

VACUUM Mold at home! Hundreds full 3-D plastic products. Big profit, new machineryless method. Free facts, samples. Nationwide Plastics, Box 23321-KP, Los Angeles 90023.

READ Progressive Mailtrade, the magazine that tells how to make money by mail. Quarter brings sample and special offer. Mailtrade, P.O. Box 357, Sheboygan, Wis. 53082.

$60.00 DAY. Manufacturing concrete posts. Carlayne, 1803 Fremont, Rapid City, South Dakota 57704.

BUY Appliances, cameras, watches, etc. at factory prices plus 10%! Free details! Cam Company, 436-13 Bloomfield Ave., Verona, N.J. 07044.

COPUBLISH "Mail Sale Advertiser," leading mailorder paper. Copy and details 25¢. Vanroy Shirk, Lebanon, Pa. 17042.

MAILORDER Catalogs. No inventory required. Discounts 40% up, postpaid. Send 25¢ for 32 page sample catalog, featuring 150 unusual, fast-moving products and complete details. Satisfaction guaranteed. Gaylords, North Adams 7, Mass.

BIG Money raising fishworms and crickets. Free literature. Carter Farms, Plains, Georgia.

CONCRETE Facts: Cement artists make big money. Previous experience unnecessary. Home shop, simple equipment, copyrighted methods and formulas. Make, color and marbleglaze beautiful cement pottery without moulds. Wishing wells, bird baths, waterfalls, rustic garden and patio items. Free illustrated brochure. Hollywood Cementcraft, 602 Athens Street, Altadena, California 91001.

MAKE Extra money — show friends, neighbors. Gifts, stationery, Christmas, All occasion cards. Experience unnecessary. Salable Samples on approval, free catalog, free name imprinted Christmas card album. Hedenkamp, 361 Broadway, Dept. PM-89, New York.

$400.00 MONTHLY Raising giant fishworms. Soilless method. Charlie Morgan, Bushnell, Florida.

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FREE Catalog of books on mailorder selling. Write, Goldmine, Box 183-A, Bloomfield, New Jersey.

RAISE/Board dogs for profit. New manual tells how to start on limited capital. Free details. Aven, Box 925-P, Jacksonville, Florida 32201.

COLORGLAZED Concrete pottery made without molds. Patented method. Cemetery products, novelties, tiles. Basement leak-sealing. Money-making projects. Booklet, details free. Men only. National Potteries Company, Grand Rapids, Minnesota.

INVESTIGATE Fires, storm damage, accidents for insurance companies, pays up to $1,000 a month, part or full time. No college necessary. Car furnished; expenses paid. We train you at home in spare time. Keep present job until ready to switch. Pick your location. Men badly needed now. Full information free. Write Liberty School, Dept. C-518, 1139 W. Park, Libertyville, Illinois.

MAILORDER. No investment in Products. Free Brochure. Methods, 1819-FD, Lafayette Hill, Pennsylvania.

ADDRESSERS And mailers needed. Send stamp for information. Lindbloom, 1508 West Erie St., Chicago 60622.

MEN—Women, Everybody likes fine candy. Make professionally home. (Our 51st year) Ragsdale Candies, B107, East Orange, New Jersey.

COLLECTION Agency, made easy. Complete set up service, training. Roberts, Box 492, Toms River, New Jersey 08753.

PROFITABLE Catalog Mailorder Business! Vikari's, 835-PM, First Avenue, Salt Lake City, Utah 84103.

FREE Book: "609 Unusual, Successful Businesses." Box 51-PN, Des Plaines, Illinois.

LEARN Bonsai! Duplicate exactly $500 imported Oriental Tiny Trees in few hours! Grow living miniatures too; and tiny forests in bowls. Profitable home business! Request free fact pack, free sample seeds! Minitree, Box 23023-VS, Los Angeles 90023.

START Your own business on credit. Your own boss. Hundreds of dealers making $100 to $300 and more weekly. We supply stocks, equipment on credit. 300 home necessities. Sales experience unnecessary. Pleasant, profitable business backed by world-wide industry. Write Rawleigh, Dept. I-U-PPM, Freeport, Ill.

WORLD'S Largest wholesale supply. Buy from 7853 American, European, Japanese wholesalers. Tailormade suits from Hongkong. 123 dropship catalogs. Rock-bottom prices. Free details. International Buyers, 216-MM Jackson, Chicago 6, Ill.

MAIL Baby catalogs to new mothers! Profitable! Northland Enterprises, Rhinelander 3, Wis.

MAILORDER: How to find new products and establish business. Write Mailways, 26-30 Windmill, Armonk, N.Y.

OPERATE Home mailorder business. Eldee Printing, 111-B Cumberland, Lawrence, N. Y.

BOOMING Mail order wig business. Market unlimited, profits unlimited. Agents needed in all states. Head O' Hair Studios, P.O. Box T, Costa Mesa, Calif.

BOOKKEEPING System. Substantial profit selling Start Service. Kern, Box 263, North Hollywood, California.

IMPORT-Export business made easy. Complete setup service. Not just instructions. Hermes, 152 West 42, New York City 10036.

PLASTERCRAFT Molds, liquid rubber, plasters, flocks, candle supplies. Catalog and manual free. Blue Rapids Supply, Blue Rapids, Kansas.

FREE Copy of top mailorder trade magazine. Mailway, Los Gatos, Calif. 95031.

MAIL Order—start overnight with Giftime's fabulous mail order color catalogs of unique giftware imprinted with your name, address. Amazing bonus plan of free Teflon cookware stimulates customer orders! Mailing lists available. Free sample catalog, details. Giftime, Dept. PM, 919 Walnut, Philadelphia, Pennsylvania.

MAKE Gorgeous original candles for all holidays and special occasions. Learn expert Candle decorating, candlemaking, use of professional molds. Free details on home instruction method. Candle Institute, Box 54-AN, Redondo Beach, California.

BIG Money. Learn electric appliance repairing at home in your spare time. How automatic washer-dryers, refrigerators, and all kinds of appliances work, how to find what's wrong using the Christy electronic trouble tracer, how to fix them. We show you how to get business, what to charge, how to buy parts wholesale. Make $5-6 per hour operating your own fix-it shop in your kitchen or basement. No previous experience or training required. Enroll now—pay later from earnings. Send for free book. Christy Trades School, 3214 W. Lawrence Ave., Dept. A-6703, Chicago 60625.

INSTALL Burglar alarms without previous experience or costly equipment. Big profit. Free details. Nasco, 11071 Massachusetts, Dept. P709, Los Angeles 90025.

MAILORDER Book publisher wants dealers. Wholesale price-list free. Neil H. Tasker, Shamokin, Pennsylvania.

FREE Valuable franchise-distributor reports. 15¢ handling. Livingstone Consultants, Shadyside, Maryland.

LOANS To start new businesses. Finance. Capital. Grants. Free details. National Counselor, Box 2206, Harlingen 17, Texas.

I MADE $40,000.00 year by mailorder! Helped others make money! Start with $10.00—Free proof. Torrey, Box 3566-Y, Oklahoma City, Oklahoma 73106.

FREE Book "990 Successful, Little-Known Businesses." Work home! Plymouth-872J, Brooklyn, New York 11218.

PROFESSIONAL Mailorder manuals reveal vital success secrets! Free details! Highland House, 27174 Cole, Highland, California 92346.

WANT-Ad Center. $200 week plan. Free details. Ad Market, Harlingen 4, Texas.

BOOKKEEPERS Operate bookkeeping tax service. Universal, Box 664-M, Springfield, Missouri.

GET List profitable items, we dropship plus sample new item, $1.00. Deejay, 12143 Buckeye, San Fernando, Calif. 91342.

RUN Book match mail order business from your home! Life-time commissions! Details, $2.00. Specialties, 4252 Fremont, Seattle, Wash. 98103.

MADE $3,065 in six weeks fund-raising! Churches and organizations. Free details, NCR-331, Harlingen 1, Texas.

NEVER Buy faucets again. Simply learn and earn "Repairing Faucet Stems" with home tools for pennies. Sell junker faucets for dollars. $1.00. F. J. DeFranco, 481—19th St. PMB9, Niagara Falls, N.Y. 14303.

TELEPHONE Your way to money. Opportunities unlimited. Edwards, Room 5M, VFW Bldg., Kansas City, Mo.

TOP Mailorder business propositions! Write: Yates, Box 356-A, Dayton, Tennessee 37321.

BUY Wigs wholesale, sell retail. Queens, Box 95B, Jamaica, N.Y. 11417.

RADIO Mail order, $50,000 in one month possible. No cost percentage plan. Walthay, Box 53-M-2, Los Angeles 90032.

THE Secret of repairing and selling water heaters and softeners. No competition. Details $2.00. Rudy, Box 7468, Robbinsdale, Minn.

MAILORDER Instruction manuals! 400% Profits! Rein, 32 New York, Freeport 38, New York.

OPERATE Profitable mailorder business. Write: Treasures, 2653 Forbes, Jacksonville, Florida 32204.

FREE Details on starting and operating successful small business. Jane, Box 36-A, Goshen, Virginia 24439.

CAPITAL Available for your idea or business. Details free. Espco, 22050 West McNichols, Detroit, Michigan 48219.

UNUSUAL Book gives key to better memory. Details free. Wilson, 433-A East Columbus, Martinsville, Indiana 46151.

SENSATIONAL Method gives you peace, power, and plenty. Details free. Dynamic, Box 555A, Forest Park, Georgia.

MAILORDER Inexpensive, foolproof way to start. Details free. Lesher, 9150A2 Fort Caroline Road, Jacksonville, Florida 32211.

"MONEY By mail," brings proven, tested money makers to start your own business. Sample copy, 25¢. Glass, Wampum, Pa. 16157.

MAILORDER Laws, $2.00. Kalvin Kahn, Attorney, 4504-S Pine, Philadelphia, Pa.

WANT To make big money at home? $10.00 profit in an hour possible with invisible mending. Make tears, holes disappear from clothing, fabrics. Steady year-round demand from cleaners, laundries, homes. Details free. Fabricon, 1585 Howard, Chicago 26, Ill.

NET $12,000 yearly through mail order. Book reveals how. Details free. Laurins, 1137 Second Avenue North, Jacksonville Beach, Florida 32050.

FREE Advertising available in Playboy, True, others. Also: how to get started in mail order. Details free. Palmer Publications, Box 805S, High Springs, Florida.

WANT Extra Money? Financial independence selling through advertisements? Write Vital, 29-A Hancock, Boston, Mass.

MAILORDER Record Book. 30 pages. Records inquiries, orders, advertising expense, etc. Most complete. Just send dime for postage and handling. C. A. Martin, Popular Mechanics, 575 Lexington Ave., New York, N.Y. 10022.

PROFIT With Popular Mechanics' subscription plan. No investment, no experience needed. Earnings begin immediately when you obtain subscription for Popular Mechanics, Good Housekeeping and others. High commissions, bonus. No experience needed. Deal directly with the publisher. Write Popular Mechanics, Room 9-B, 250 West 55th St., New York 19, N.Y.

MONEYMAKING OPPORTUNITIES

LEARN The secrets of repairing junk batteries. "Fabulous Profits" at home. Details. The Batteryman, P.O. Box 416, Palm Desert, Calif.

MAKE Figurines, plaques, lawn ornaments. Molds, plastercraft kits, liquid rubber. Sample and catalogue 10¢. Wooley Company, Box 29-B, Peoria, Illinois.

VENDING Machines. No selling. Operate a route of coin machines and earn amazing profits. 32-page catalogue free. Parkway Machine Corporation, 715 PMM Ensor Street, Baltimore 2, Maryland.

EARN Money evenings, copying and duplicating comic cartoons for advertisers. Adservice, Argyle-1, Wisconsin.

CIGARETTES. Make 20 plain or filter-tip for 9¢. Factory-fresh pipe tobaccos. Mild tropical flavored Philippine cigars. Facts free. Moberly, Box 904, Owensboro, Kentucky.

SELL Titania gems: more brilliant than diamonds. Catalog 10¢. Diamonite, 2420-G 77th, Oakland 5, California.

EARN $240.00 a month at home, spare time, doing only two $5.00 invisible mending jobs a day. Big money paid for service that makes cuts, tears disappear from fabrics. Steady demand. Details free. Fabricon, 1532 Howard, Chicago 26, Ill.

MINK Raising information free. Lake Superior Mink Farm Inc., Superior, EE1, Wisconsin.

BIG Money raising fishworms and crickets. Free literature. Carter Hatchery, Plains, Georgia.

NEW Instant invisible mending. Learn in one hour, repair in five minutes. Make $150.00 week. Literature free. Louis Rosenstein, P.O. Box 6136-6, Philadelphia, Pa. 19115.

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HOT Money making line! Show line of business printing, advertising specialties, calendars. Watch orders pour in. All repeat items. Terrific commissions in full or spare time. No experience, no investment. Cash discounts to customers. Free bonus gifts to you. Free sales kits. Willens-David Lionel Press, Dept. W-27, Waukegan, Illinois.

AMAZING Successes through franchises! Become exclusive franchise holder your territory. Information rushed. National Franchise Reports, WP-528, 333 North Michigan, Chicago 1.

$500.00 MONTHLY Possible addressing envelopes. Write Wellings, R2, Phillipsburg, N.J. 08865.

SPARETIME Opportunity! Typewriter required. Refundable homework instructions, $1.00. Interstate, 37-1 Besch, Albany 9, New York.

SELL By Mail! Rare opportunity! Fascinating facts! A. Nelson, 210 Fifth Avenue, New York, N.Y. 10010.

MAKE Plastic novelties for extra income. Low cost home training now available. Write for free booklet. Interstate Training Service, Dept. D-3, Portland 12, Oregon.

WORK Home, part-time, mailing our catalogs! Free details! Cam Company, Dept. 53, Verona, N.J. 07044.

EARN Big commissions full or part time. Show America's largest line low priced business printing and advertising specialties. Calendars in seasons. Big free sales kit samples hundreds items used daily by business people. Build profitable repeat business. Start right now. National Press, Dept. 19, North Chicago, Illinois.

Free, 206 Easy ways to make money in spare time taking orders for exciting new products. No charge. Just send name, age, for five months free subscription to Opportunity Magazine, 850 N. Dearborn, Dept. 17-GM, Chicago, Ill. 60610.

WIN Contests! Free sample copy. Prizewinner, Box 11569, St. Petersburg, Fla.

EASY To start rubber stamp business at home in spare time. Make up to $9.80 an hour without experience. Facts free. Write Roberts, 1512 Jarvis, Room CR-2-HW, Chicago 26.

MEN — Women! Start money-making plastic laminating business at home in spare time. Material that costs 11¢ brings back $2.58. No canvassing or selling but mail orders bring in $20 a day. Write for full particulars free. Rush name on postcard to Warner, Room CL-2-HW-A, 1512 Jarvis, Chicago 26, Ill.

CASH In with your typewriter! Details! Liu—PM, Box 4759, Chicago 60680.

MAKE Money reading your newspaper! LIU-PM2, Box 4759, Chicago 60680.

DIRECTORY Of study courses; Money-making Opportunities, $1.00. ABC Sales, 366 Rio Verde, Daly City, California 94014.

FOREIGN Forum magazine, International trade publication incorporates "Wholesale Digest" and "Drop-Ship Gazette." Importers, exporters, agents, mailorder dealers, gift shops, salesmen, merchants, reach new markets, new contacts thru worldwide circulation. Sample copy, 35¢. 4 issues subscription, $1.00. None free. Forum, Box 4361, Chicago 60680.

SHARP $$$$ Opportunity! One low-cost machine sharpens—serrates knives, scissors, pinking shears. Earn $6-$9 hourly in spare time. Professional results without experience. Free details. Beaver Machine, Box 121, Gardena, California.

MAKE Money writing short paragraphs! No tedious study! I tell you what to write, where and how to sell, and supply list of editors buying from beginners. Many small checks add up quickly. Write to sell, right away. Send for free facts. Benson Barrett, Dept. C-27-HA, 6216 No. Clark, Chicago 26.

RAISE Rabbits and fishworms on $500 month plan. Free details. White's Rabbitry, Mt. Vernon, Ohio.

WHOLESALE Buyers! Mailorder operators! Direct salesmen! Goldmine in profitable opportunities. Regar, Box 683P, McMinnville, Tennessee.

MAKE Big easy profits making costume jewelry at home, spare time! Quick, easy to make; easier to sell! Details free! Don-Bar, 2934 Fullerton, Dept. K-205, Chicago, Ill. 60647.

EARN Big money fast! Take easy orders for Dwarf, Semi-Dwarf, standard fruit trees, roses, ornamentals. $1,000 profit in 60 days possible. World's oldest, largest nursery. Spectacular full-color selling outfit free. No investment. Stark, Desk 30196, Louisiana, Missouri 63353.

MAKE Money, while vacationing, holidays, week ends. Instructions easy, results guaranteed. Instructions, $1.00. Joe's, P.O. Box 1115-P, Modesto, California 95353.

CLIP Items from daily newspapers. Get $1.00 to $5.00 each. Details free. Walter, Box 1023-P, Erie, Penna.

EARN $10,000 yearly repairing batteries at home. Full or part time. No experience necessary. American, Box 56, Muncie, Kansas.

EARN Thousands yearly, selling books by mail! Romain House, 1810-PM, Romain, Columbia, South Carolina 29210.

START Your own home mailorder business, sparetime! Easy; fascinating; profitable! Alfano, 19-PM, Pine, Closter, New Jersey.

$200.00 FROM Sheet of plywood, 25¢ refundable. Novelties, 610 So. 24th, Elwood, Indiana.

ARTISTIC Interiors Cast Tile Brick Plaques Changeable Letter Signs. Duchess, 1005 First Avenue, Des Plaines, Ill. 60016.

FABULOUS Profits raising fishworms. Guaranteed market. Free picture folder. Excello, Kosciusko, Mississippi 39090.

$1.00 PUTS You in business. Great, new, sure-fire way to make $250-$500 a month in spare time. Mail special post cards to select list of buyers. No other costs! Send $1.00 for kit containing generous supply of order-getting cards, plus complete instructions on this fabulous, easy, money-making plan. Haase, 18-J Broadway, Denville, New Jersey.

TELEPHONE Your way to money. Opportunities unlimited. Edwards, Room 5P, VFW Bldg., Kansas City, Mo.

MAKE Good money, spare or full time, with almost no investment. Details free. Stamp appreciated. John Frank Co., 648-PM No. Damen, Chicago, Ill. 60622.

EXCLUSIVE 77 Page guide. Build profitable mailorder business. Buchwalter Sales, 834—175th St., Dept. 29, Hammond, Indiana 46324.

SIGNS Easily painted by you with our letter patterns, supplies, raised letters. Paulow, Crystal Falls, Michigan 49920.

200% PROFIT Possible investing in coins. Free details. Smith Publications, 3380 Kallin, Long Beach, Calif.

FREE Literature! Planned profits, all ages. Postal okay: Aladdin Research, Box 5183-H, Oakland, California 94605.

HOMEWORKERS Needed. Tremendous profits. Information free. Parkland, 7T Bay, Little Rock, Arkansas 72204.

$5.00 EACH For local names! Send stamped envelope. Marvler, P.O. Box 907-P, Aurora, Illinois.

BIG Profits selling books by mail. No inventory necessary. Free details. Laurins, 1137 Second Avenue North, Jacksonville Beach, Florida 32050.

CASH In on prize contests. Learn how. $1.00. Laurins, 1137 Second Avenue North, Jacksonville Beach, Florida 32050.

PROFITABLE OCCUPATIONS

BAKE New greaseless doughnuts in kitchen. Sell stores. Free recipes. Michael, 3605 South 15th, Minneapolis 7, Minn.

BIG Money raising fishworms and crickets. Free literature. Carter Wormery, Plains, Georgia.

EARN $240.00 A month at home, spare time, doing only two $5.00 invisible mending jobs a day. Big money paid for service that makes cuts, tears disappear from fabrics. Steady demand. Details free Fabricon, 1586 Howard, Chicago 26, Ill.

AUCTIONEERING—Resident and home study courses. Auction School, Ft. Smith, Ark.

VENDING Machines. No selling. Operate a route of coin machines and earn amazing profits. 32-page catalogue free. Parkway Machine Corporation, 715 PMP Ensor Street, Baltimore 2, Maryland.

INVESTIGATE Accidents. Earn $750 to $1,400 monthly. Car furnished. Expenses paid. No selling. No college education necessary. Pick own job location. Investigate full time. Or earn $8.44 hour spare time. Men urgently needed now. Write for Free Literature. No obligation. Universal, CPM-9, 6801 Hillcrest, Dallas 5, Texas.

PHOTOGRAPH Accidents for Insurance Companies. $10.00 hour spare time. Not a school. Free information. Underwriters PMM, 7400 Pershing, St. Louis, Missouri 63130.

WHOLESALE Magazine subscriptions. Highest commissions. Bonus! Box 151JA, Freshmeadows, N.Y. 11365.

BECOME Independent with your own franchise business. Thousands earning handsome incomes. Request interesting facts today. National Franchise Reports, PM-528, 333 North Michigan, Chicago 1.

SCIENTIFIC Massage: Big earnings, uncrowded profession. Learn spare time at home. Diploma awarded. Free catalog. Write: Anderson School, Dept. J1-C, Princeton, Illinois.

MAKE Money writing short paragraphs. Information free. Barrett, Dept. C-27-HB, 6216 N. Clark, Chicago 26.

EARN Good money part time, repairing sewing machines. Easy. Dignified. Lincoln, Box 52, Hempstead, New York 11551.

CHROME Plating. Instructions, equipment and supplies. Platers' Supply, P.O. Box 565, Lugo Station, Los Angeles, Calif.

SHARPEN-Scissors, pinkers. Inexpensive equipment, tools, supplies. Blackhawk's, Sheldahl, Iowa.

FREE Book "990 Successful, Little-Known Businesses." Work home! Plymouth-87J, Brooklyn, New York 11218.

POLAROID Camera owners! Earn immediate cash! Instructions, 25¢. Carstens, 406-PM South Second Street, Alhambra, California 91802.

YOUR Own sign shop—Signs, 1017 W. Mulberry, Springfield, Ohio.

AGENTS WANTED

PRINTING. Advertising salesmen—Excellent moneymaking sideline selling decalcomania name plates, small quantities. Automobile initials, sign letters. Free samples. Ralco, XL, Boston 19, Mass.

YOUR Own business—Used suits $1.50; overcoats 65¢; mackinaws 35¢; shoes 12½¢; ladies coats 30¢; dresses 15¢. Enormous profits. Catalog free. Nathan Portnoy Associates, 2109-AA Roosevelt Road, Chicago 8, Ill.

MAKE $50.00 daily selling air operated vacuum cleaners to service stations. Free details. Inka Industries, 2401 Crocker, Houston 6, Texas.

MAKE Extra money — show friends, neighbors. Gifts, stationery, Christmas, All occasion cards. Experience unnecessary. Salable samples on approval, free catalog, free name imprinted Christmas card album. Hedenkamp, 361 Broadway, Dept. PM-89, New York.

ESTABLISH Your own business. Low prices on used clothing, shoes, household goods. Unlimited profits. Free catalog. Northwestern Distributors, 2129 No. Western Avenue, Chicago, Illinois 60647.

AMERICA'S Biggest value wedding line! Big 40% profit showing wedding invitations and over 50 exciting accessory items. Ideal sideline for Christmas card, printing salesmen. Write for free display album. Elmcraft, Dept. EW-158, 7201 S. Cicero, Chicago, Illinois 60629.

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CHRISTMAS Cards, business and personal. Customer's name imprinted. Earn unusually high commissions from this medium—and high-priced line. Free sample album. Process Corp., (our 44th year). 3432B S. 54th Ave., Chicago, Ill. 60650.

SALESMEN Make big profits selling "do-it-yourself" sign kits to merchants. Information free. Signmakers, Inc., Dept. PM4. Box 6626, Denver 16, Colorado.

RUN Spare time greeting card-gift shop at home! Show friends samples of new 1965 Christmas, All-occasion greeting cards, gifts! Take orders. Earn to 100% profit. No experience needed. Try without cost! Special fund raising plans for organizations. Rush name for samples on approval. Regal Greetings, Dept. 173K, Ferndale, Michigan.

MEN! Show wife this amazing offer! Famous nationally advertised Hollywood cosmetics pay big. Make $25 day up. For free samples, details, write Studio Girl, Dept. OP-346, N. Hollywood, California.

RAISE Rabbits for us on $500 month plan. Free details. White's Rabbitry, Mt. Vernon, Ohio.

TEAR Out this ad, and mail with name, address for big box of home needs and cosmetics for Free Trial, to test in your home. Tell your friends, make money. Rush name. Blair, Dept. 31BT, Lynchburg, Va.

BUSINESS Kit free! Postcard puts you in business! Complete line 275 shoe styles, jackets; New discoveries pay big commissions. No investment. Send for free kit. Mason, Chippewa Falls K-535, Wisconsin.

FREE 48-pc. party set given to introduce new Christmas money-makers. $75.00 profit on hundred $1.25 card assortments. 230 exciting card, gift sellers. Biggest profits; bonuses. Personal Christmas album Free. Approval assortments. Creative, 4401 Cermak, Dept. 514-K, Chicago 60623.

WILL You test new items in your home? Surprisingly big pay. Latest convenience for home, car. Send no money. Just your name. Kristee, 143, Akron, Ohio.

SELL Permanent social security cards. Details free. Sample, $1.00. Phillips, Box 102P, Cortland, N.Y.

BRAND New patented idea. Magnetic casters distributors. Needed in every home. For samples and information, $1.00 to L. E. L. Enterprises, Ltd., Box 4931, Vancouver 10, British Columbia, Canada.

BIG Commission: Selling books, several lines. Free details. Carter Company, La-Plaza Acres, Searcy, Ark.

MAKE Up to $50.00 daily soliciting delinquent accounts. Terrific commissions. General Finance Co., Dept. LG-77, Pickwick Bldg., Kansas City, Mo. 64106.

SALESMEN—DISTRIBUTORS

$1,000.00 a month for making dramatic 3-second demonstration of amazing Lightweight Presto Fire Extinguisher. New chemical used by Airforce snuffs out fires instantly. Only $4.95. Terrific commissions. Millions want it. Free Kit. Merlite, 114 E. 32nd, Dept. P-66N, New York 16.

LONG-Needed invention. Man to contact service stations. Huge profits. Cyclo Mfg., 3816 Dahlia, Dept. 143, Denver 1, Colo.

SENSATIONAL New longer-burning light bulb. Amazing free replacement guarantee—never again buy light bulbs. No competition. Multi-million dollar market yours alone. Make small fortune even spare time. Incredibly quick sales. Free sales kit. Merlite (Bulb Div.), 114 E. 32nd, Dept. C-73N, New York 16.

EARN Big commissions full or part time. Show America's largest line low priced business printing and advertising specialties. Calendars in season. Big free sales kit samples hundred items used daily by business people. Build profitable repeat business. Start right now. National Press, Dept. 18, North Chicago, Illinois.

FREE To salesman, descriptions and pictures 200 new, fast sellers for spare time cash or side line profits. No charge. Just send name, age, for sample copy Opportunity Magazine, 850 N. Dearborn, Dept. 17-G, Chicago, Ill. 60610.

JOBBER Selling car dealers quality blue diamond wax, good repeat two dollars trial can. Hasco Products, 7100 Schaefer, Dearborn, Mich.

EARN Extra money selling advertising book matches. Sample kit furnished. Matchcorp, Dept. PM-95, Chicago, Illinois 60632.

SELL Advertising book matches. Write us today, we put you in business by return mail; handling complete line ad book matches in demand by every business right in your town! No investment; everything furnished free! Top commissions daily! Superior Match, Dept. M-965, 7530 S. Greenwood, Chicago 19, Illinois.

GET New shirt outfit free! $90 weekly on 5 average orders a day. Famous quality made-to-measure dress and sports shirts at $4.50 up, sell to all men. No experience needed. Full or part time. Write: Packard Shirt Co., Dept. 309, Terre Haute, Indiana 47808.

ASTONISHING Automatic toilet bowl cleaner, deodorizer. Works when toilet is flushed. Housewives buy on sight for every bathroom, at only $1.98 each. Make up to $10.00 in hour, spare time. Free sales kit. Merlite, 114 East 32nd, Dept. G-71N, New York 16.

MEN, Women, canvassing one item that sells on sight. $150.00 weekly. Car necessary. Rural area preferred. Free sample. We finance you. Rajotte, 164 W. 81st St., N.Y., N.Y. 10024.

CALENDARS. Novelties. Full or part time. Liberal commissions. Fleming, 6535-A Cottage Grove, Chicago 37.

HOT Money making line! Show line of business printing, advertising specialties, calendars. Watch orders pour in. All repeat items. Terrific commissions in full or spare time. No experience. No investment. Cash discounts to customers. Free bonus gifts to you. Free sales kits. Willens-David Lionel Press, Dept. W-28, Waukegan, Illinois.

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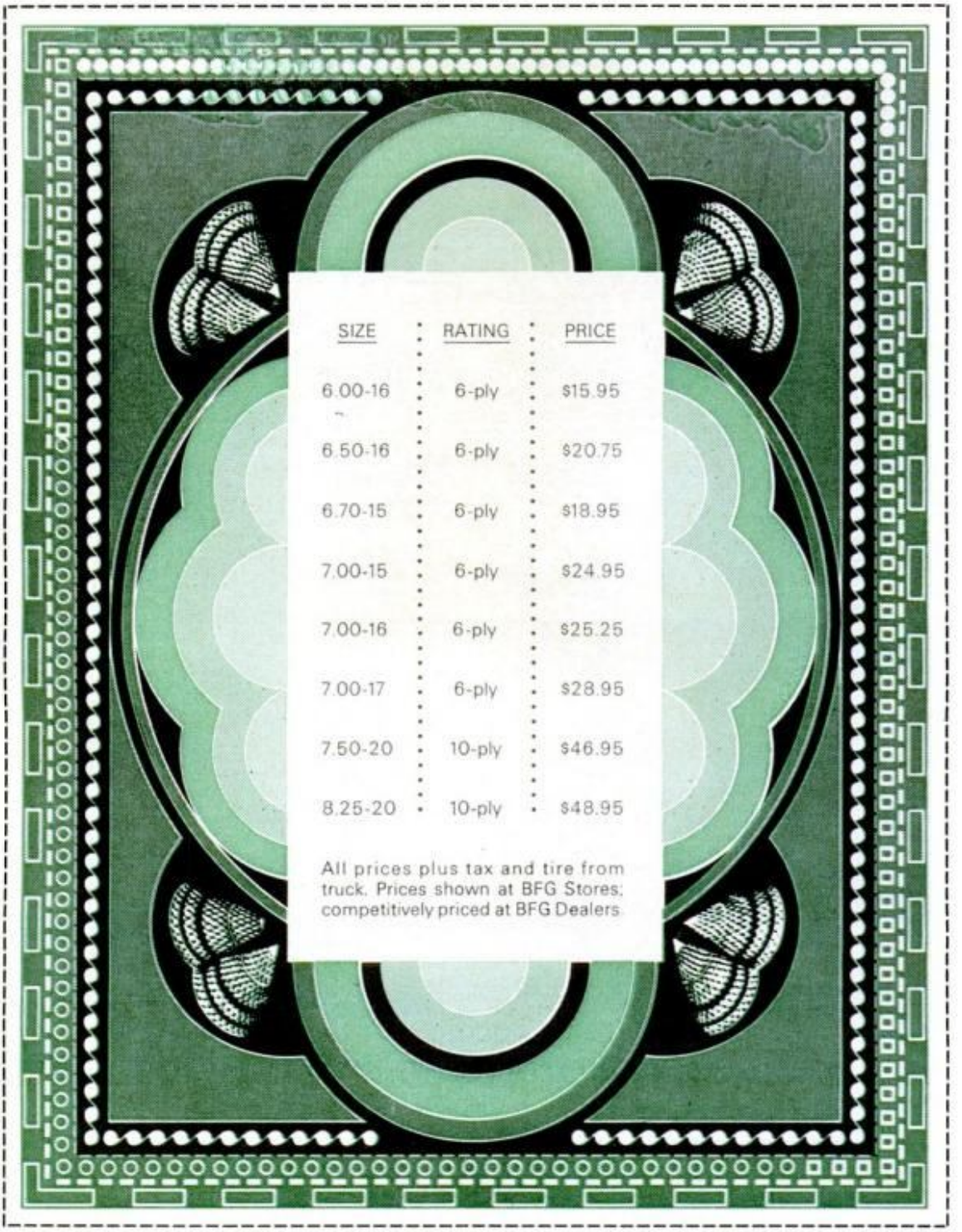

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Roselle Park Tire Co., Westfield Ave. & Locust
Toms River
Minerva Tire Service, Flint Rd.
Trenton
Heath & Wildblood, 1432 Hamilton Ave.
Whippany
Gogel Chevron Service, 2 Parsippany Rd.

NEW YORK

Albany
B.F. Goodrich Store, 1043 Broadway
Bayshore
Bayshore Rubber Works, 161 E. Main St.
Brooklyn
Alamac Tire Distributors, 630 Foster Ave.
Buffalo
B.F. Goodrich Store, 1050 Main St.
Canton
Hundley Farm Impl. Inc., 62 E. Main St.
Dunkirk
B.F. Goodrich Store, 423-25 Central Ave.
Ellenburg Depot
Wilmer Nephew Impl. Service
Elwood
County Tires Inc., 1976 Jericho Turnpike
Endicott
Kearing Tire Service, 236 Vestal Ave.
Garden City
Golub Tire & Rubber Co., 2260 Jericho Turnpike
Huntington Station
Sheehan Tire Co. Inc., 91 E. Jericho Turnpike
Jamestown
B.F. Goodrich Store, 405 W. Third St.
Madrid
Kelly Sales Corp., 10 State St.
Malone
West End Service, 119 W. Main St.
Martville
Kyle Farm Machinery
Mexico
Jerrett's Gulf Service, Main & Scenic Sts.
Middletown
Suresky's Tire Service, 111-112 North St.
Newburgh
B.F. Goodrich Store, 303 Broadway
New Rochelle
Mallory Tire & Auto Service Co., 20 E. Main
Niagara Falls
B.F. Goodrich Store, 928 Main St.
Ogdensburg
Fred Shurtleff's Inc., Washington & Catherine
Olean
B.F. Goodrich Store, 112 N. Barry St.
Oneonta
Hamm's Tire Center, 300 Main St.
Oswego
Fruit Valley Tire Co., Route 104 W.
Plattsburgh
A. Brown Auto & Home Store, 319 Cornelia St.
Air Base Texaco, 4 U.S. Ave.
Port Henry
Whellocks Garage Inc., 78 S. Main St.
Poughkeepsie
B.F. Goodrich Store, 605 Main St.
Riverhead
Rolle Bros., Route 58
Rochester
B.F. Goodrich Store, 385 Ridge Rd., W.
Rome
Pettinelli Motors, Martin St.
Stapelton
L & F Tire Co., Vanderbilt Ave. & Targee St.
Syracuse
Barnet-Hewett Tire Co. Inc., Onondaga & Myron
B.F. Goodrich Store, 627 Erie Blvd., E.
Brothers Tire Co., 749 W. Genesee St.

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Pawtucket
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DeBlois Oil Co., Colfax & Concord Sts.
E. Providence
Devaney Tire, Inc., 741 N. Broadway

VERMONT

Barre
A. Brown Auto & Home Store, 395 N. Main St.
Brattleboro
Fleming Oil Co., 3 Walnut St.
Burlington
B.F. Goodrich Store, 227 Main St.
Enosburg Falls
A. Brown Auto & Home Store, 158 Main St.
Morrisville
A. Brown Auto & Home Store, Rts. 15 & 100
Rutland
Ray Reilly's Tire Mart, 219 Woodstock Ave.
St. Albans
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Washington, D.C.
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Satellite Telephone Call to PM

On June 28, a telephone in the office of Richard E. Deems, president of Hearst Magazines, rang with urgent persistence. The caller was Richard Thomas, Popular Mechanics' foreign editor who headquarters in the Paris office of our French edition published by Monsieur Adrien Albarranc.

What was remarkable about this particular transoceanic telephone call was that Thomas' voice was coming, not by cable, but via Early Bird satellite in outer space. This chat marked the first time that man had communicated commercially from continent to continent via an orbited satellite.

It was achieved at the world opening of the Early Bird commercial frequencies, in the midst of inaugural ceremonies in Paris. French Minister of Communications Jacques Marette had opened the ceremonies; President Lyndon B. Johnson, speaking from the White House, had stressed the good will that would come from the new and unique communications channel. COMSAT executives added their good wishes. At 1:30 p.m. EDT, Vice-President Wingert of AT&T, officially opened the commercial facilities of COMSAT's space satellite HS 303. The first circuit to New York was powered, and Popular Mechanics' Richard Thomas was invited to take the 'phone and place the first commercial call.

The historic signal, traveling 50,000 miles to the Early Bird relay and back to Earth, triggered the telephone in the Hearst offices one quarter of a second after it was sent. The two men talked for several minutes. Richard Thomas reported to us that there was no time-lag echo whatever. "Dick Deems," he said, "seemed to be talking from the next room."

Thomas later called the Overseas Press Club, of which he is a member. The significance of all this is that the United States is seriously in commercial business in outer space, and PM is proud to have been part of the opening operation.

PM Editor's Page

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750 MPH...HERE I

Bucking shock waves, aerodynamic instability, local sonic flow and other possibly fatal gremlins, the driver of a new "Spirit of America" will head for Mach I

By Craig Breedlove

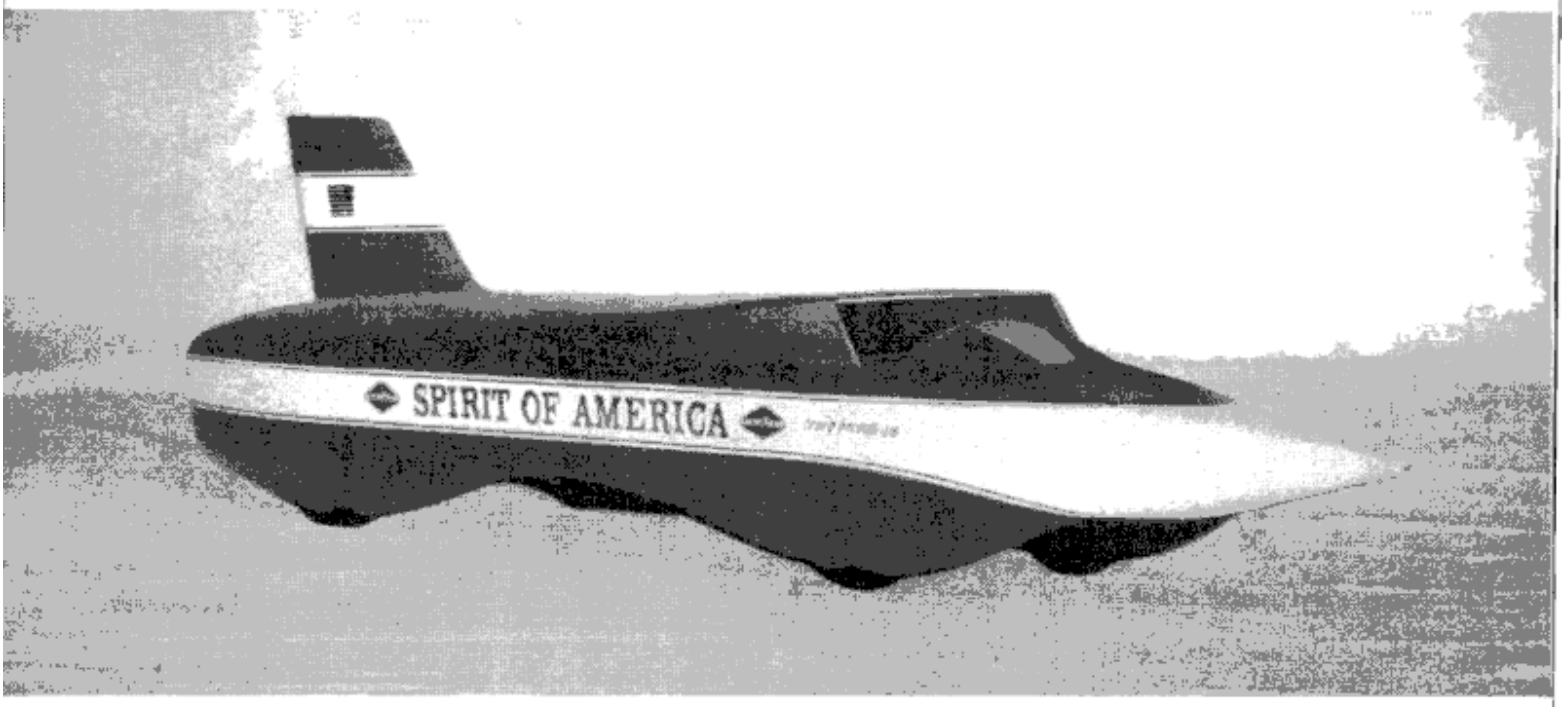
A LOT OF PEOPLE said I was crazy when I told them I could drive "Spirit of America" at 500 mph. Yet I did better than that. I averaged 526 mph both ways on the Bonneville salt in Utah.

I wonder what they'll say now, when they read that I'm planning to drive a new car at the speed of sound or faster.

A sonic boom like an explosion will sweep out in front of me. It may create a traffic problem on busy transcontinental U.S. 40, only a couple of miles from the end of the world land speed record course. We may have to stop cars to prevent possible accidents when my shock wave slams across the road.

We know of half a dozen invisible gremlins that will be trying to trip me when the new "Spirit of America" approaches the speed of sound. One of these gremlins is called local sonic flow.

ROARING ACROSS THE BONNEVILLE SALT FLATS, here's what author Craig Breedlove's new Spirit of America will look like. The pinched-in waist design was chosen carefully to control speeds of air flow over the car's surface



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Air that travels around the curved portions of the car has to travel farther, and hence faster, than the air that flows over its straight surfaces. This means that when the new "Spirit" is approaching Mach I there will be sonic or even supersonic air flows at places like the curve of the nose and the curved cockpit canopy.

Some of these areas may light up with the dazzling glow called the Lambda effect. It's the same "line of light" phenomenon that passengers sometimes see dancing and shifting on the wing of a fast jet airliner.

One reason why local sonic flows are dangerous is because they can change a vehicle's center of pressure, making it unstable. If the front end goes sonic, the center of pressure may shift forward or aft, depending on design. The car could yaw or try to roll. The front tires might squash into the salt, or the front end could lighten and let the nose lift.

Another danger of sonic flows is that they can suddenly reverse a car's stability. That is, I may find that at a certain speed the car starts drifting to the left, and I'll correct for this. But a couple of seconds later and 100 mph faster the car may start the same left drift and then reverse its drift. If I had started to correct, I'd be over-correcting. I'd be in big trouble. I'll have to wait part of a second to see what the car is really going to do.

Local sonic flows create local shock waves, and the timers, halfway down the course will hear a boom when the car hurtles past. But observers at the far end of the course won't hear one unless the whole car reaches Mach I. They could use the boom, or lack of it, as an unofficial speed indicator.

True sonic booms will be generated by several parts of the car at Mach I or faster, and these pressure waves will hit the ground and bounce back against the vehicle. But at the "low" supersonic speeds I eventually hope to reach, these overpressures shouldn't cause trouble.

Walt Sheehan, my chief technical advisor and a Lockheed research specialist in supersonic aircraft, points out that we are in a brand new field of scientific research. Never before has anyone tackled the problem of driving faster than 750 mph on wheels. Besides, there's the

ALTHOUGH PARACHUTE 'BRAKES' FAILED after the last record run, he'll try again with special 'chutes. They'll sprout from compartment beside jet exhaust

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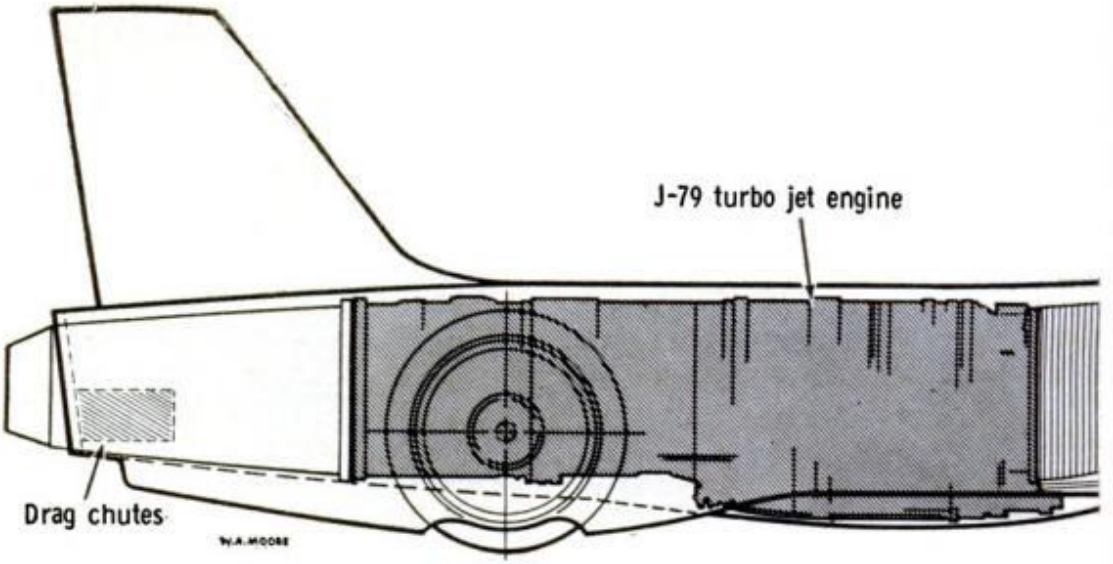


"ground effect"—the cushion of air that builds up just above the ground. We don't know yet what problems will be created by this phenomenon.

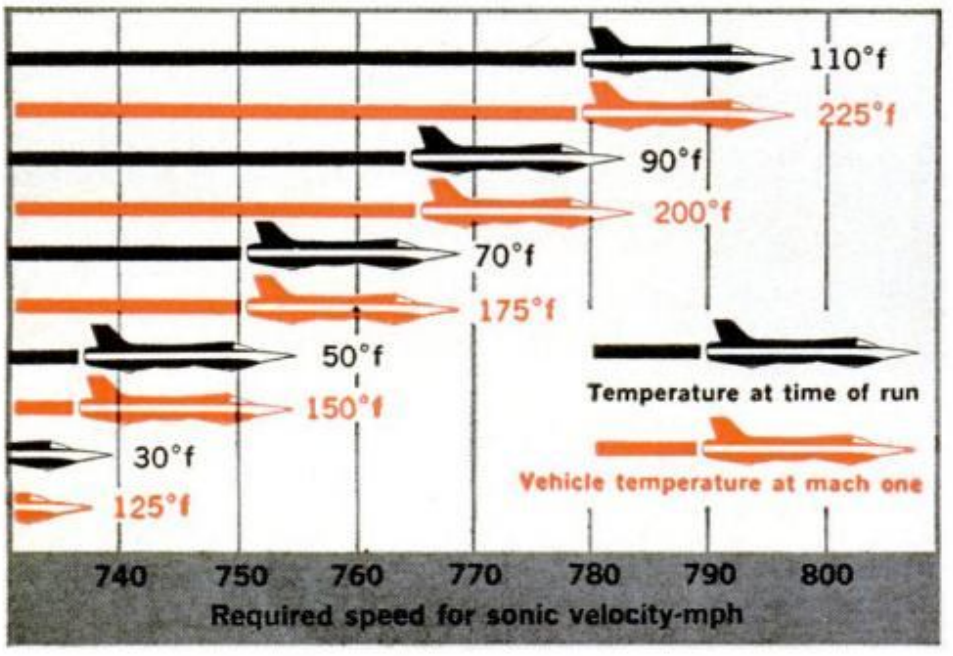
Another gremlin we are contending with is skin temperature. The new car can go so fast that aerodynamic heating becomes a problem. Even though we'll run during the coolest part of the day, right after dawn, the skin temperature will climb to around 160 degrees at Mach I. The transparent canopy has been designed so it won't warp or come apart at high temperature.

Too, the hot skin heats up the air in the intake duct, expanding and thinning it. This could cause a flame-out by upsetting the critical air-fuel ratio. Furthermore, the inflowing air is blocked and some of it spills back out of the duct inlet. The car becomes unstable and hard to control.

A heat stall isn't as likely in high speed aircraft because they travel in colder air, often as cold as 55 degrees below zero. And if an aircraft's engine does flame out, the plane can wander from a straight path without harm. On land there's only one, ultimate penalty for not steering straight at Mach I.

When you look at the new "Spirit" you might suppose that its shape just hap-

SPEED OF SOUND CLIMBS AS AIR TEMPERATURE goes up. Thus, in order to break the barrier, Breedlove must run faster as temperature rises. And as his speeds rise, so will the temperature (color) of his new Spirit of America



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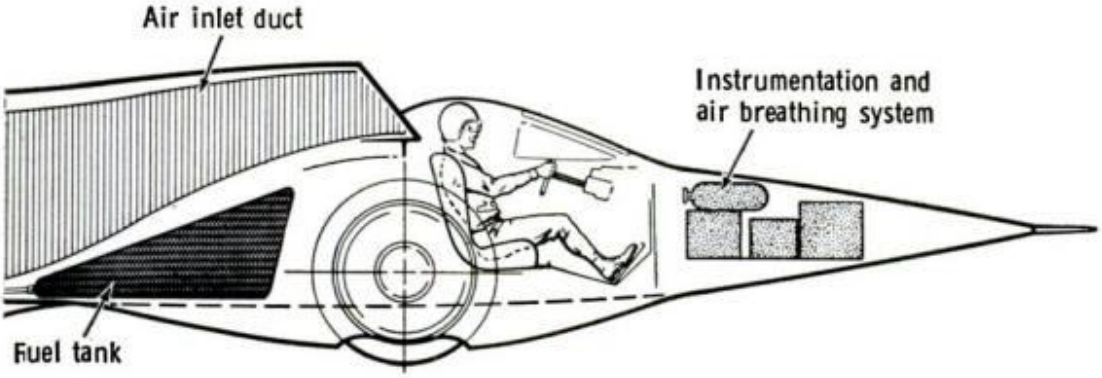
LAYOUT OF THE MAIN COMPONENTS of the new Spirit of America is shown in this cut-away drawing. The far-forward location of driver means his canopy will generate desired shock wave where outside air is ducted into jet engine



pened to come out like that as an obvious way to streamline the chassis. The fact is there's a purpose for every curve, a reason why each feature is placed where you see it.

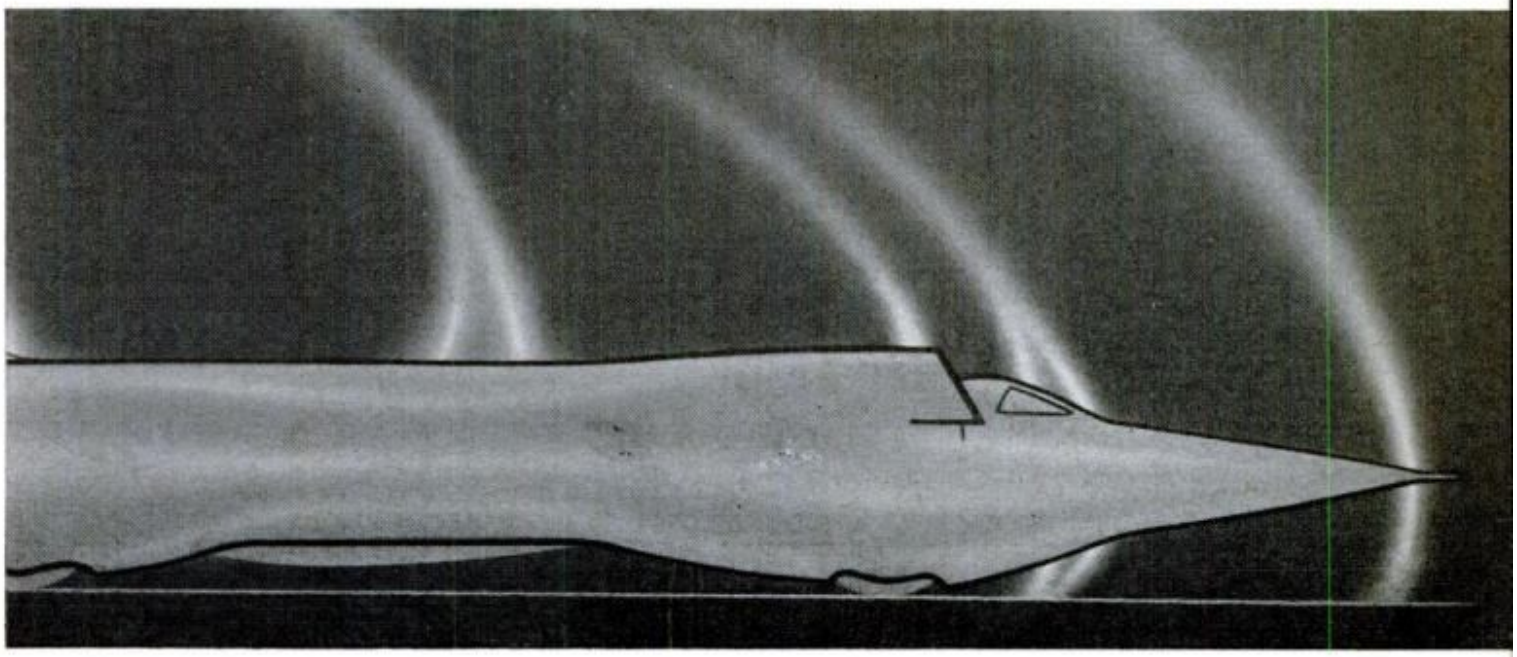
The car has a slight coke-bottle shape, for instance, because this helps balance the areas of local sonic flow when Mach I is being approached. This insures the best stability. The shape also helps diminish any problem from ground effect.

Our first design, late this past winter, had a tall, thin swept-back tail. This has been shortened and made longer across the root for more rigidity. If the tail should flutter at high speed it could tear apart and put the car out of control.

The air intake is placed on top of the car where it can't sweep up foreign objects—even salt could be a problem—from the course. It's located pretty far forward to allow space in the duct for good air distribution before the air enters the engine.

Personally, I'd like to sit farther aft so I'd get maximum use of the nose as a "front sight." But there's a good reason why we placed the cockpit up front, just ahead of the duct intake. It's the same reason we changed the original long, narrow cockpit canopy to a wide wrap-around canopy that follows the curvature

SHOCK WAVES HAMMERING THE SPIRIT'S SURFACE may shift their location as car speed builds up. This drawing shows where they'll be after Breedlove's car shatters the sonic barrier. His first attempt is planned for this fall



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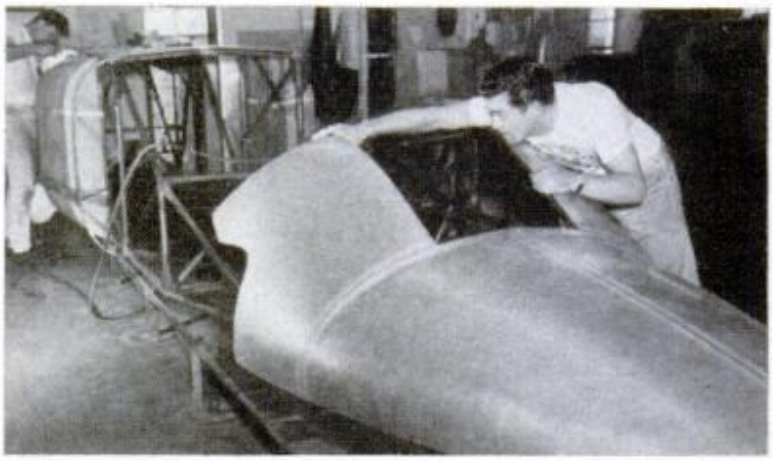
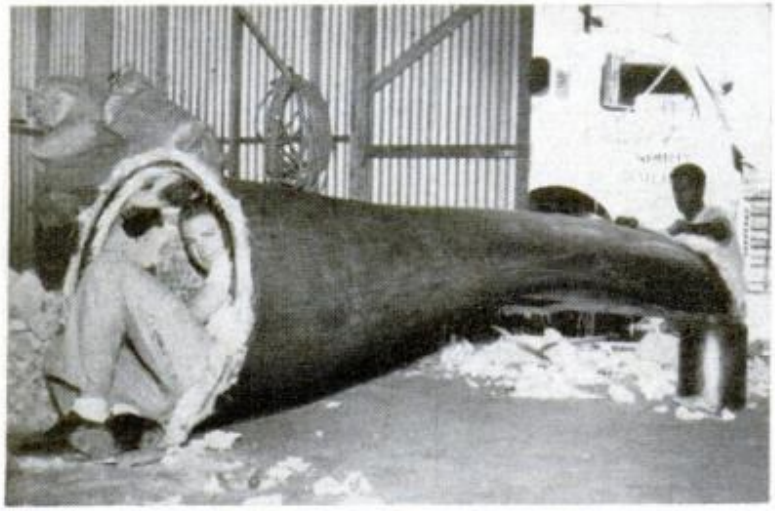
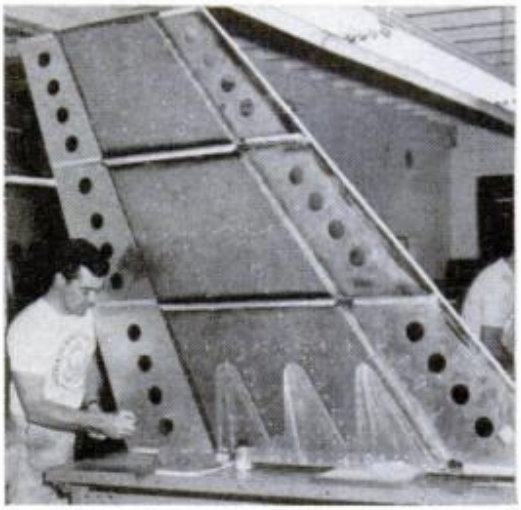
FANTASTIC SPEEDS OF THE SPIRIT'S TIRES have called for special tests by Goodyear to develop "shoes" that won't pull away from the wheels as Breedlove attacks the sonic barrier

HOW DOES IT FIT? AUTHOR-DRIVER Craig Breedlove checks the fit of a section of aluminum skin before it is attached to the chrome-moly frame of the new Spirit of America record car





AIR WILL FLOW FROM THIS END of the intake duct into Spirit's J-79 jet engine. At right, a workman is shaping the intake end of the fiberglass duct. Shape will minimize jet's scream



CRAIG BREEDLOVE (left) works on aluminum core of the tail fin. It will be filled out with foam, covered with fiberglass

of the air inlet over the top of the car.

Walt Sheehan explains that the new canopy will create a shock wave at Mach I and that one is needed at this location to slow down the air flowing into the duct. With velocity reduced, the air pressure goes up. This insures engine performance and reduces the risk of a heat stall.

Walt designed the duct so that the air flowing through it will generate a minimum of noise. Otherwise the loud, shrill scream of the rushing air would be too painful for me to tolerate. He put a slot just below the duct inlet to bleed off boundary layer air for engine cooling. (The car has some other features I'm not discussing yet.)

Power is no problem. The J-79 powerplant develops more than 10,000 lbs of thrust, over 15,000 lbs. with afterburner.

Last year a lot of "experts" doubted that a supersonic tire could be built. And they thought that such a tire would "grow" so much from centrifugal force that it would come loose from the rim.

Goodyear, my principal sponsor, solved that problem this summer. The new tires, pressurized to 250 psi, have been tested successfully at 850 mph. Goodyear's engineers estimate that at this speed the centrifugal pull on the tires amounts to two million pounds, about a thousand times the centrifugal force exerted on a passenger car tire at 60 mph.

The rear tires measure 8.00 x 39. on 39-

(Please turn to page 228)

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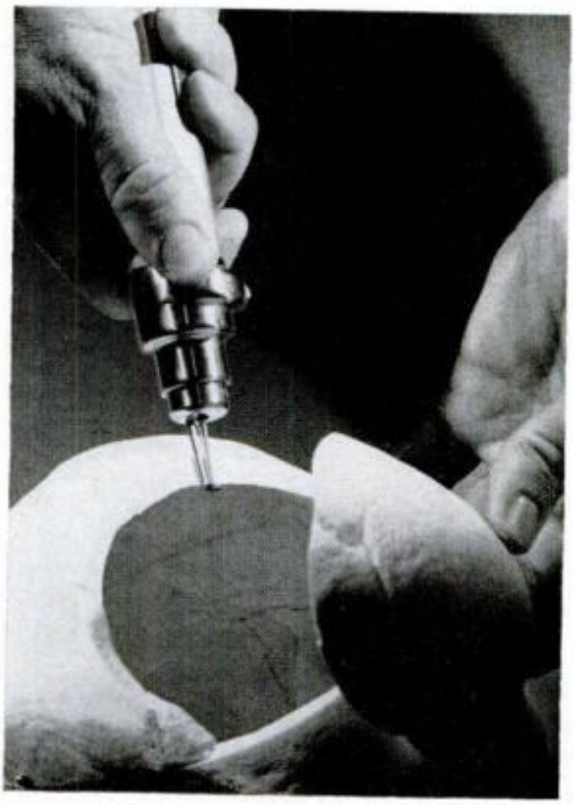
Panel Railroad

Track and scenery are integrated in the "All-Aboard" model railroad. The layout comes in panels, each composed of track and scenery such as crossings, houses, bridges. Panels are connected by means of the interlocking track. Maker is A.C. Gilbert.



Fast Surgical Tool

An air-powered tool now makes it possible for brain surgeons to remove the top of the skull in minutes—an operation that normally takes an hour.

Called the Neurairtome, the instrument was developed by Robert M. Hall, a Pittsburgh oral surgeon. It weighs less than a pound and spins at speeds up to 24,000 rpm. In use, the tool is inserted into a drilled hole and the circular cut is made in one continuous motion. A metal guard prevents the tiny whirling blade from coming in contact with brain tissue while the cutting is under way.

Metal Sculpture

You don't have to be a Picasso, or even an experienced solderer, to create pieces of sculpture in an afternoon with a new solder-sculpture kit.

You just pop out prenumbered metal shapes, bend and cut them and solder to hold the parts together.

The soldering iron, shears and one of eight models make up an $8.95 kit. By Wanamaker, Dayton, Ohio.

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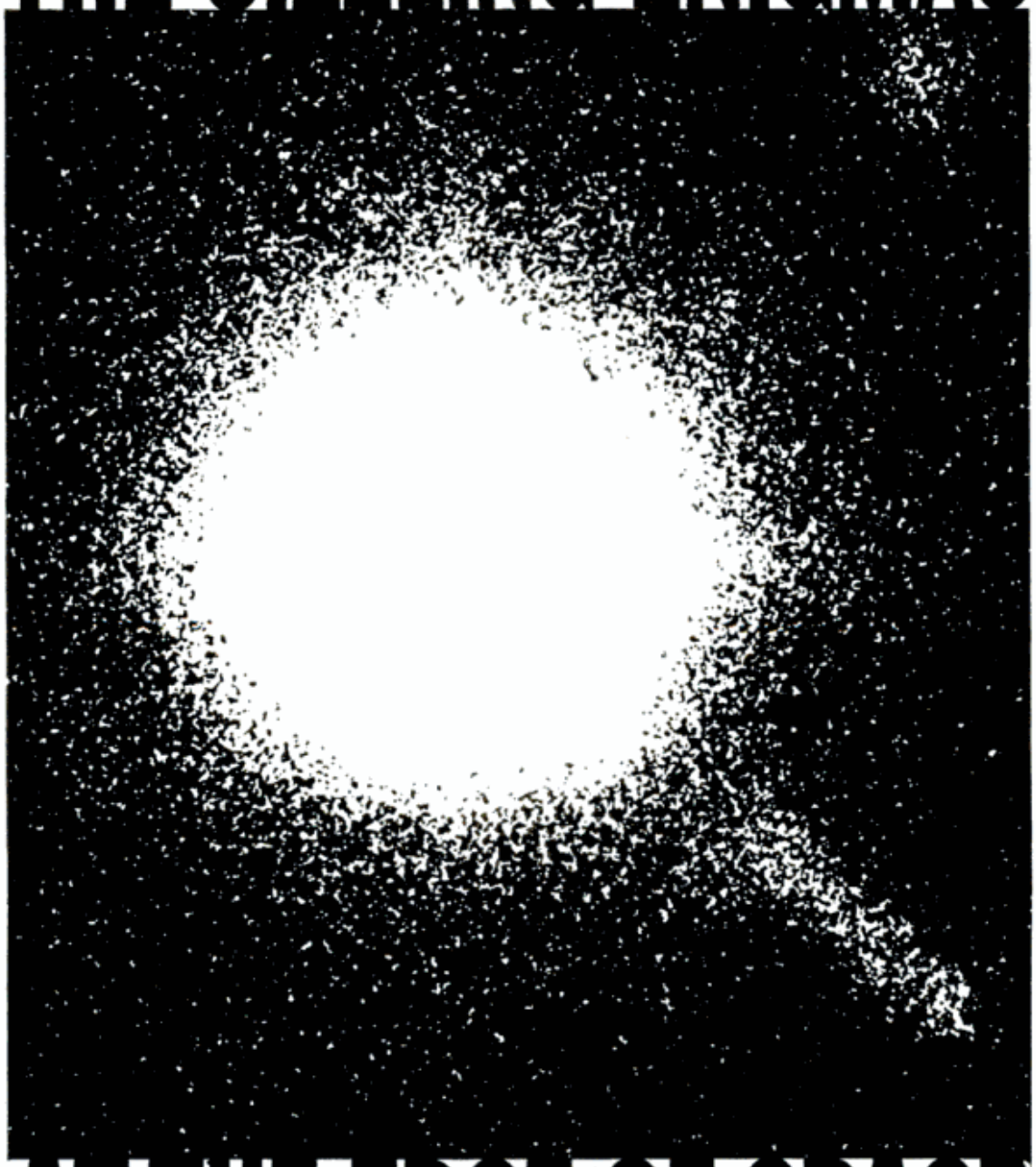
PM SCIENCE MYSTERY

THE SIZZLING ENIGMAS AT THE EDGE OF SPACE



Quasars are the oldest, fastest, brightest objects ever seen in space. They may hold the secret of the universe

By John F. Pearson

BRIGHTEST OF THE QUASARS, 3C 273 shows exploding gas jet in photo made with telescope

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AUSTRALIA'S biggest radio telescope is a concrete and steel monster that towers 18 stories above quiet wheatfields in Parkes, New South Wales. Its bowl-like antenna is 210 feet in diameter and is capable of catching radio impulses that have traveled billions of light-years. It cost almost $2 million to build.

WORKING in Australia, Dr. Cyril Hazard figured out an unusual way to pinpoint some of the mystery radio sources. The plan produced very accurate locations.

It's not the kind of instrument that prudent scientists ordinarily would put hammer and wrench to and partly dismantle. But that's exactly what happened in early 1962, shortly after the telescope had been commissioned.

The scientists had a compelling reason. They were anxious to pinpoint the location of newly discovered sources of radio waves, sources that poured incredible amounts of energy into space. They were—and still are—perhaps the most awesome and most puzzling phenomena ever discovered by man. Called quasars (for quasi-stellar radio sources), these newly discovered energy sources may even hold the secret of the origin of the universe—if there was an origin.

IN CALIFORNIA, astronomer Allan R. Sandage aimed the big Palomar telescope at a point determined by Dr. Hazard. He found nothing unusual, only what seemed to be a very dim star.

The Australians decided to tinker with their expensive instrument in order to overcome one of the limitations of radio telescopes: Because many of the waves they receive are measured in feet and even in yards, they can't focus as sharply as a telescope that handles light waves, which measure less than a ten-thousandth of an inch.

A 200-foot antenna, for example, can't locate a radio source with an accuracy greater than several minutes of arc—an area so big that a photographic plate of it will contain not one but dozens of objects.

One way to lessen the problem is to use two widely separated telescopes to zero in on a source. But the Australian group had only one telescope. They hit on another method. They knew that several of the radiating objects were eclipsed by the moon at certain times. When the moon passed between the earth and the source, radio signals would be abruptly cut off. They would resume just as suddenly when the moon had passed over.

ASTRONOMERS couldn't make sense of the spectrums of the newly discovered objects. Then Dr. Maarten Schmidt came up with idea that led to the identification of first quasar.

Since the moon's orbit is

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accurately known, the points of eclipse and the resumption of signal could be determined. The two points could then be used to pinpoint the source within a *second* of arc—a degree of accuracy that optical astronomers can work with.

The man who came up with the plan was Cyril Hazard, a tall, young British astronomer. But there were practical problems involved in the procedure, as Hazard later explained. A preliminary tracking of one of the objects brought them to light.

The radio source was eclipsed when the moon was directly overhead from the telescope and reappeared 62 degrees below this point. But the telescope was designed to be swung down only 61 degrees, after which its rim would hit the ground.

"So we dug a trench to accommodate the rim," explains Hazard.

There were safety devices to prevent the dish from going below the 61-degree mark. "We disconnected them," says Hazard.

And then there were cogs in the machinery to keep the rim from hitting the ground. "We tore them off."

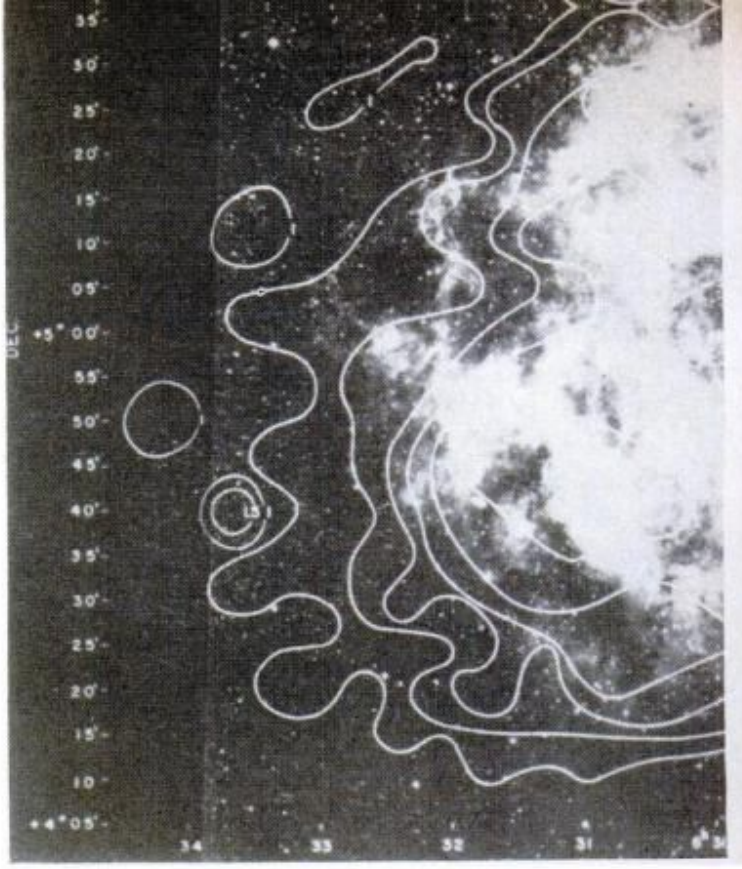
Finally, there was the possibility of a power failure at a crucial moment. So the scientist taught workmen how to hand-crank the big telescope at the proper rate to keep it on target.

But the power didn't fail. The plan worked perfectly. Radio impulses from the mysterious object in space were picked up by the antenna, electronically boosted in the amplifier, and then translated into thousands of inked squiggles on long tapes.

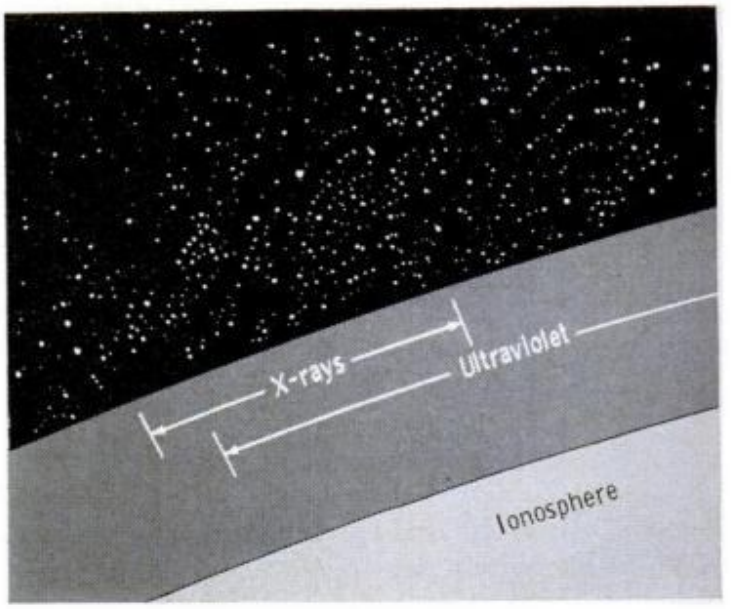
Two complete records were made. Hazard flew with one set to a computer center 200 miles away, and a colleague followed with the second set on another plane. "Just in case of a crash," explains the laconic Hazard.

After processing, the information was sent on to the Mount Wilson and Palomar Observatories in California, home of the 200-inch reflector that can peer farther into space than any other optical instrument on earth. Astronomer Allan R. Sandage and a colleague used the data to make a number of photographic plates, each showing many, many objects. But among them and right where the Australian group had said it would be, was a starlike speck of light.

It was identified as 3C 273 (No. 273 of the Third Cambridge Catalogue of Radio Sources), long thought to be a star of little



RADIO AND OPTICAL telescopes "see" objects somewhat differently. Here, radio contour map of Rosette nebula, a gas cloud, overlaps optical photo



consequence in our own galaxy. This actually was the second quasar to be identified. Earlier, in 1960, Sandage had traced another radio source—3C 48—to what had been designated a star in the constellation Triangulum. He and his colleagues were still puzzling over that one when 273 came along.

If the identifications were correct—and they certainly seemed to be—what appeared to be stars were radiating radio energy with the power of whole galaxies.

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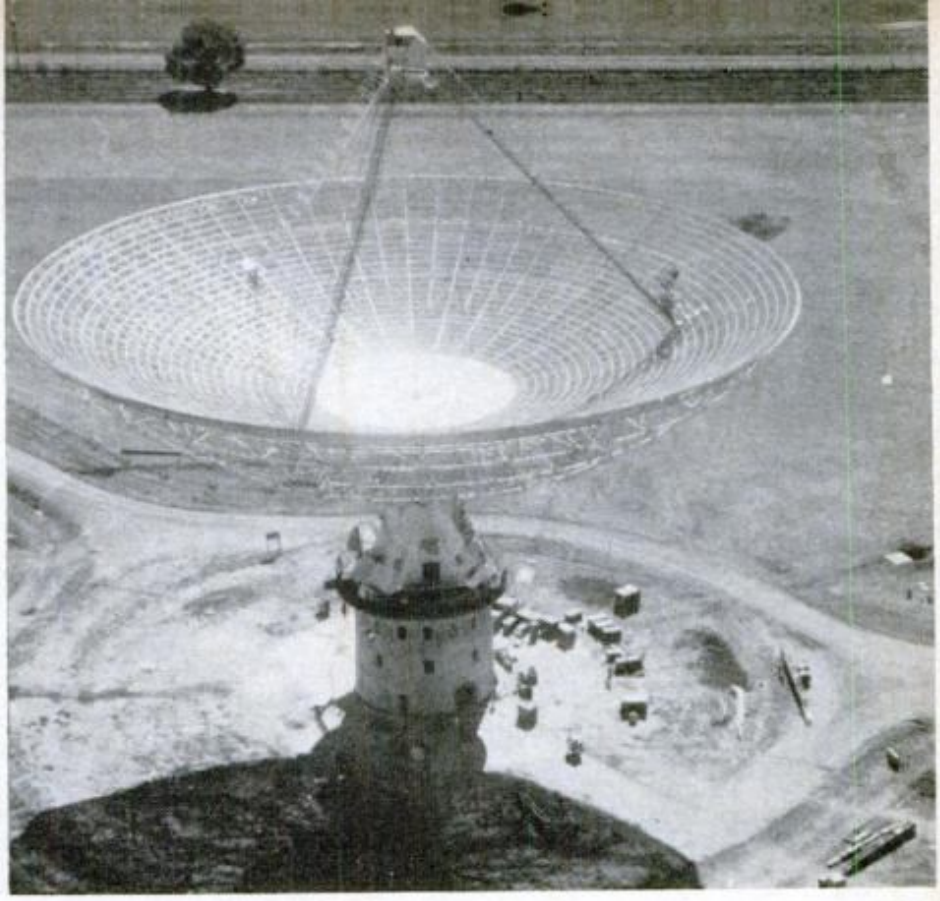
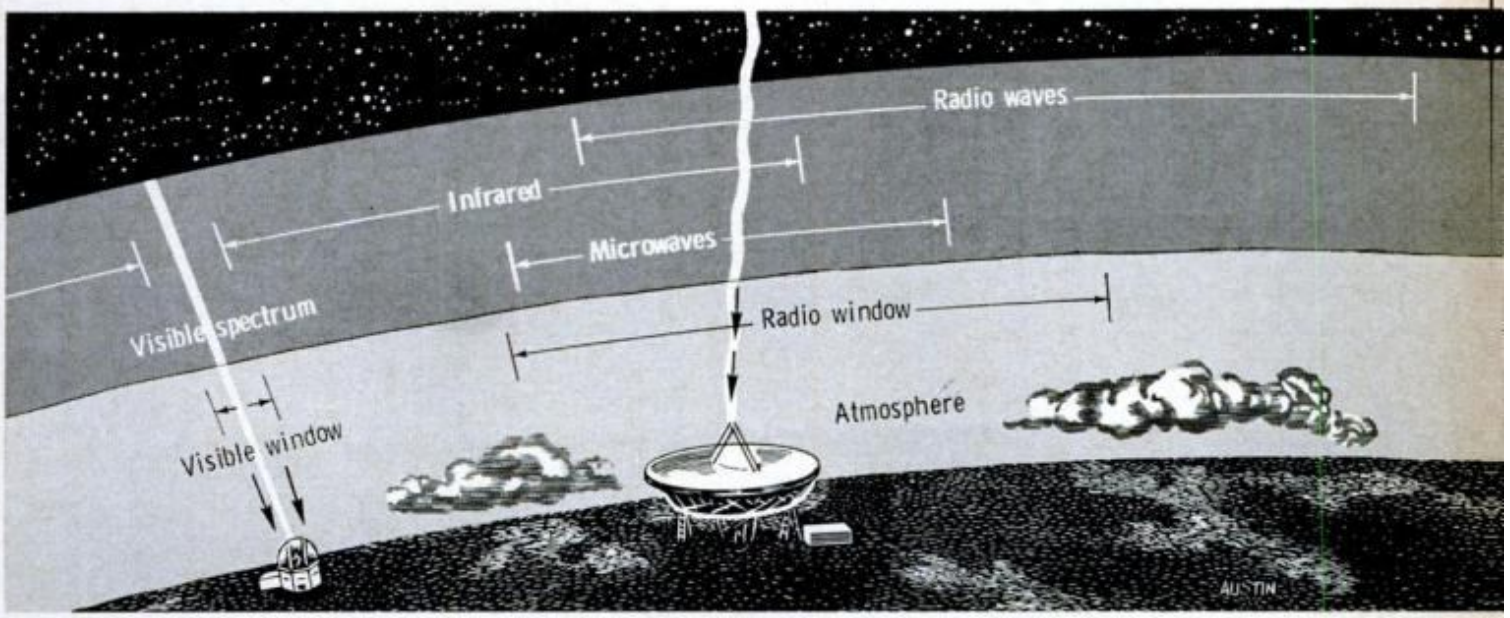


RADIO TELESCOPES look through a bigger "window" than do optical jobs. As diagram (below) shows, the atmosphere absorbs much of energy from space

QUASAR FINDER: Australia's Parkes telescope sits atop a 40-foot concrete tower and can rotate 360 degrees. It captured the radio waves from 3C 273



Up to then in the young science of radio astronomy, most radiating sources had been identified as galaxies or as remnants of supernovas—huge explosions of stars.

Celestial objects radiate energy right across the electromagnetic spectrum. Thus, the earth is bombarded by X-rays; by ultraviolet, infrared and visible light rays; by radio waves. The atmosphere absorbs much of this radiation, but allows a band of light and a much broader band of radio waves to get through.

Much of the radio energy is created by what scientists call synchrotron radiation: When basic charged particles (electrons and ions) spiral in a magnetic field, they emit radio noise. Picked up by antennas on earth, it sounds, say scientists, "like pebbles bouncing on a tin roof." It's that noise, translated into inked lines or a series of numbers, that the astronomers work with.

Our sun, like other ordinary stars, radi-

(Please turn to page 232)

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They Help Stamp Out

A firebug goes on the prowl, a camper gets careless, a farmer burns off a blueberry hillside—but the man who keeps our forest resources from burning up is the gumshoeing smoke-eater sleuth

By Frank Tinker

IN MONTANA a curious bear bites into a box of matches, sets them off, and thousands of acres of virgin forest land go up in smoke.

A careless tourist driving up California's coast highway tosses a cigaret from his car, and within hours firefighters are on the job.

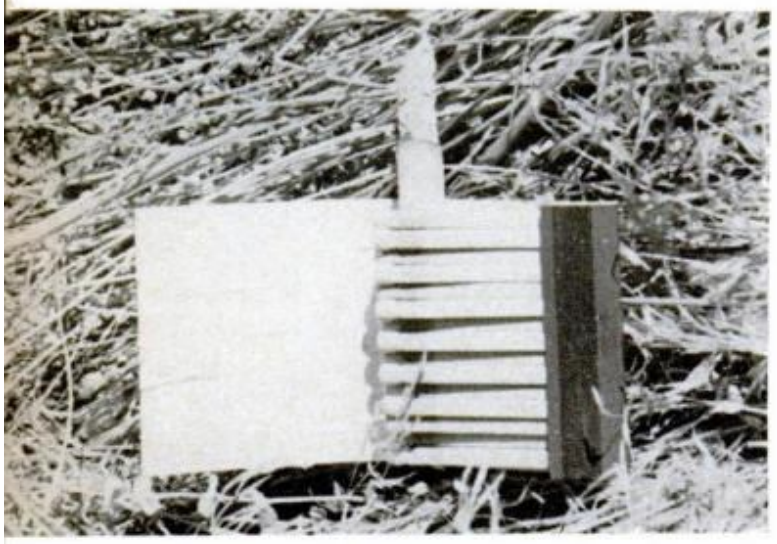
In Pennsylvania a camper is using kerosene to remove the ticks from his dog; the animal breaks loose, runs madly through the campfire and becomes a torch, setting a forest fire that rages for three days.

And in each case, while the embers of the extinguished fire were still warm, a group of highly-trained specialists went to work, covering the charred terrain with the educated sense of a bloodhound, looking for clues with the studied care of a Sherlock Holmes. These are the fire investigators of the U.S. Forest Service, and their job is to discover the cause of every fire on government land.

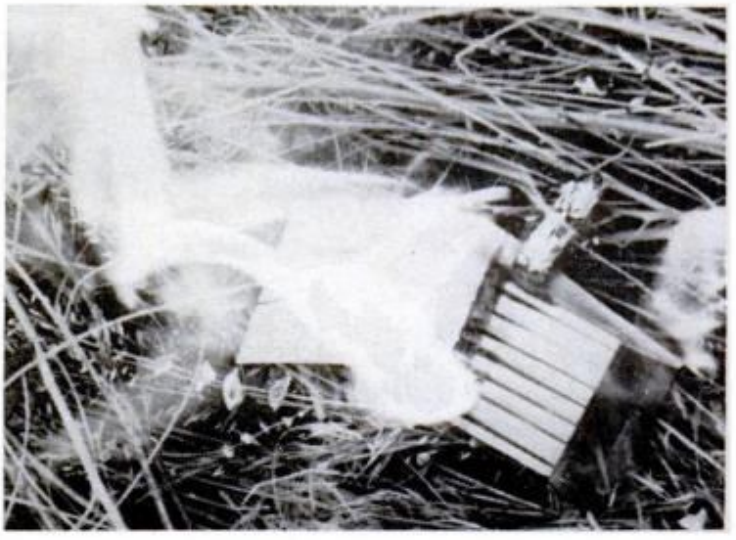
There is no such thing to these outdoor sleuths as a blaze of "unknown" origin. And while much of their work deals with accidents and carelessness, their major quarry is a killer more destructive than any hoodlum—the pyromaniac.

Observant tourists passing through California's Angeles National Forest in 1961 might have thought the rangers there had a strange hobby, furtively copying license numbers of all visiting cars. But this was no casual game. It was a desperate last-ditch hunt.

Fire investigators combing the remains of the 1957 Mt. Baldy fire had found the telltale signs of the firebug: cigaret butts, tire prints, the ashes of a simple device used to trigger the fire. This was not unusual, because the deliberate set-



TYPICAL FIREBUG "SET" is a lighted cigaret and a book of matches, a device quickly traced; it was placed in grass with small dry twigs piled about



WHEN THE CIGARETTE reached the matches they exploded, setting the grass and twigs afire. This "set" gave the firebug ten minutes to make his getaway

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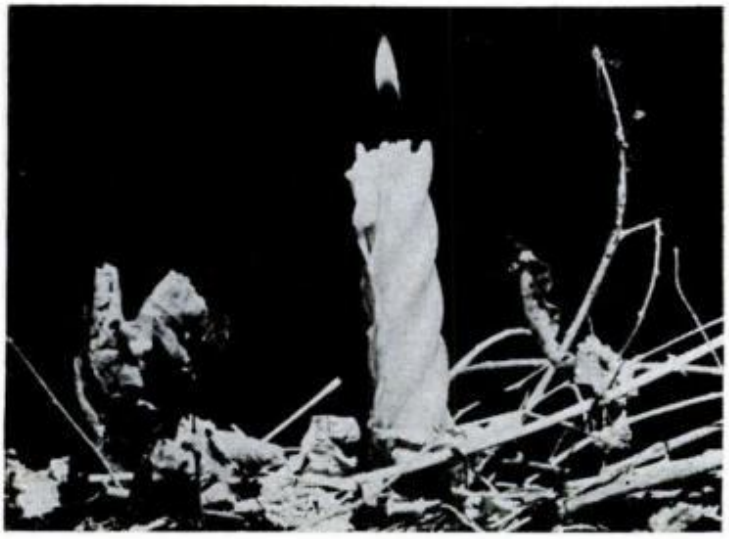
Firebugs

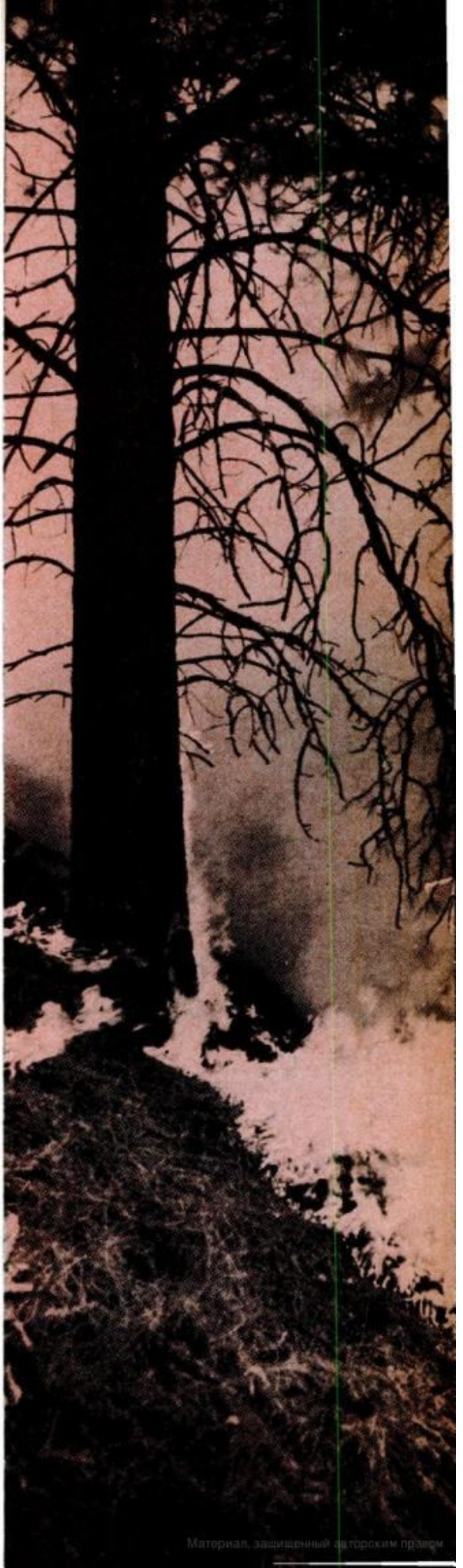
ting of fires—the action of a diseased mind —is a common occurrence. But during the next five years this same set of clues had turned up at more than 40 fires in the area.

Being the most heavily traveled forest in the nation, with dry slopes thickly covered with brush, it proved a maddeningly difficult job to thwart or apprehend this maniac. A moment's pause along a back road, a quick placement of his "set" at the bottom of a wooded canyon—this was all the time the firebug needed. In 1961, after all other leads had been exhausted, fire and law enforcement officers turned in desperation to the laborious task of recording the license numbers of all cars entering the forest and running a check on the owners of those numbers that appeared with any frequency during the fire seasons.

It was not until 1962 that they got results. One number turned up on their lists with regularity. It was registered in the name of a local resident, and his visits coincided with a rash of fire outbreaks. A routine check was placed on the suspect's house and his movements were carefully followed. Finally, on August 13,



SIMPLE BUT DEADLY, a lighted candle stuck in a pile of brush gave a firebug plenty of time to leave the scene, but the forest fire sleuths got him anyway



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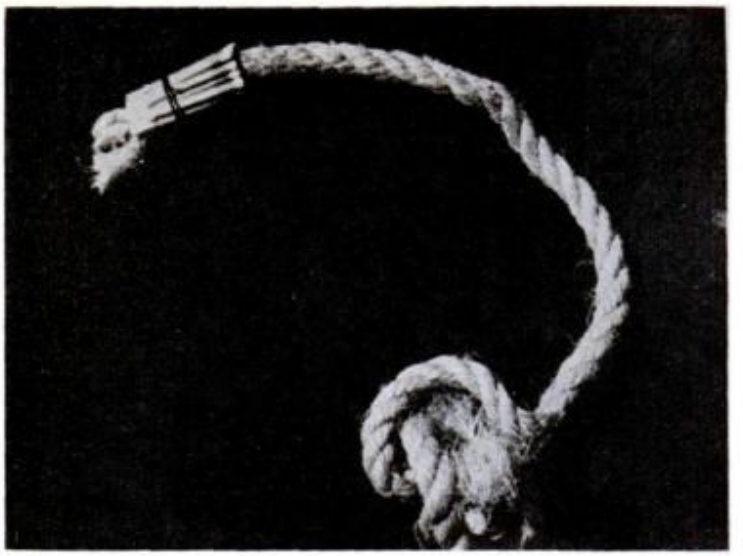

BURNING SLOWLY BUT STEADILY, a length of dry rope acted as a fuse that set off a book of matches tied to one end; even this method leaves telltale clues

the local resident left his house in his car and drove to Webb Canyon, one of the thickly-grown arroyos that were a fire danger in the dry weather. While investigators watched, a plume of white smoke rose from the canyon.

The alarm was given and the rangers moved in for the arrest. But even with this prompt action, 2000 acres burned before the blaze was brought under control.

Confronted with a string of evidence the firebug confessed to starting 60 fires.

It is the constant threat of the firebug that keeps firefighters on edge. But carelessness is also a potent villain.

Recently, a lookout in a northwest forest spotted a car speeding away from a camping site even before smoke was visible. By the time he had spotted the fire and turned in his alarm the fleeing campers were beyond immediate reach. The fire was quickly extinguished, and then forest personnel verified the cause as a poorly tended campfire. Other campers were interviewed, camp permits were checked, and the state police were notified. Within hours the fleeing vacationers were apprehended. They admitted that they had panicked when the flames of their fire had spread to the forest and had fled to avoid the blame.

There is a tendency to sympathize with this type of luckless individual, but in 1963 there were 24,521 fires started by "accidents" of this nature. In 1962 a total of 4,300,000 acres of national forest land went up in smoke, and approximately 4 million acres were burned by man—

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ONE THAT DIDN'T WORK, a cigar used in place of a cigaret would not continue to burn without being inhaled. This saved thousands of acres of forest

FOUND NEAR THE SCENE of a forest fire, this device was judged to be the cause. It is a roll of paper soaked in kerosene and tied to a length of rope

either through accident or deliberately.

Aside from carelessness and incendiaries, there were "freak" accidents that took their toll of forest land. In Missoula, Mont., for example, a logger was stung by hornets, and he became so enraged that he threw gasoline on their nest, set fire to it, and then had to race to keep ahead of the ensuing blaze. In another case the firefighters were called out after some surveyors tried to remove an annoying ant hill with kerosene and a match. In Black Hills National Forest in South Dakota a rash of fires were set by surplus Russian ammunition. Hunters were using unmarked tracer bullets that set fire to the underbrush. A really unusual freak happened in Sequoia National Park in California. Riding his brakes on the steep, twisting road out of the park, a tourist got the brake bands so hot that they set fire to a tire that blew clear off the rim and set fire to the brush alongside the road.

Animals can also be offenders. Birds have short-circuited power lines and started fires. Beavers have accomplished the same thing by dropping trees across a powerline. And birds have also started fires by adding a lighted cigaret or cigar to their nests.

Thus it is often difficult for the fire investigator to make certain that he actually has a firebug at work. The most definite proof lies in finding the actual mechanical source of the fire. Since even a slight breeze will take the flames away from their origin in a definite fanlike pattern, the expert first backtracks along this fan and pinpoints the starting point within a few square yards. A minute search here, even the sifting of ashes, may turn up a charred piece of rope, a series of match stubs, a bit of wax—all decisive clues in this deadly game.

But even before these clues are evaluated, the investigator may find an overwhelming motive which leads to the culprit. A disastrous fire which swept a California canyon in the early 1950s and left several persons dead seemed to be of incendiary origin, but no material proof turned up immediately. Investigators found, however, that an unemployed cook had been seeking work in the forest.

"When there's a big fire here," he had been told, "we'll need you."

They located the man, questioned him intensively, and obtained a confession that he had simply taken the employers at their word and provided them with a fire. Ordinarily, forest personnel are careful about avoiding any suggestion that fires will provide work, because this man was not unique. During the depression years, setting a forest blaze to obtain a job putting it out was considered as legitimate as leaning on a public works shovel. This idea has not disappeared by any means. Lumbering areas are afflicted with this philosophy on the part of marginal workers and whenever business slackens investigators must include this as a possible cause for any outbreak of fires.

Grudge fires are also astonishingly common. In 1959, for instance, a Forest

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FOREST SERVICE SLEUTH makes a plaster cast of a footprint found near the scene of a fire. Such casts have helped to build a case against many firebugs

FIRE CONTROL BOARD at the headquarters of a National Forest pinpoints a fire minutes after smoke has been seen, then flashes the alarm to firefighters

DIVING LOW OVER A BLAZE, a forest service plane bombs the area with fire retardants. This aerial show tempts many vandals to deliberately set a fire

FIGHTING A FIRE calls for tons of equipment and supplies and is very costly. This depot is just a small part of what would be used on a large fire

Service employee used a flaming paint brush to set fire to the Angeles National Forest, burning 14,000 acres and killing two men. His reason: simply that he felt his vacation time had been withheld unfairly by his supervisors. Again, investigators used the motive rather than material evidence in solving their case.

In the southlands, such grudge fires give forest personnel a constant headache. The easiest way of eliminating unwanted neighbors or settling family feuds is by fire. Even more costly, however, are the traditional burning practices with which southerners have "greened up the land." Despite a campaign of education begun in 1957, this practice is still out of hand. In 1962, for instance, the Forest Service's western Region Three reported only 5 incendiary fires; the southern Region Eight had 376! Running gun battles have been fought in Louisiana between backwoods burners and state foresters. Governor Orval Faubus of Arkansas told a forestry conference in 1956 that he "would hate to count the number of acres" which he had burned as a lad.

Because this practice is so widespread and often done in the honest belief that it improves grazing, investigators here have had to rely on public education for long-range prevention. For an immediate preventive, they have turned to aerial observation and modern sleuthing ways.

Several years ago two youths with criminal records went on a grudge-fire spree and set a two-mile string of blazes in the backwoods of the Shawnee National Forest. Missouri Conservation Commission pilot Bob Larkins, who was patrolling nearby state land in an aircraft, swung

(Please turn to page 216)

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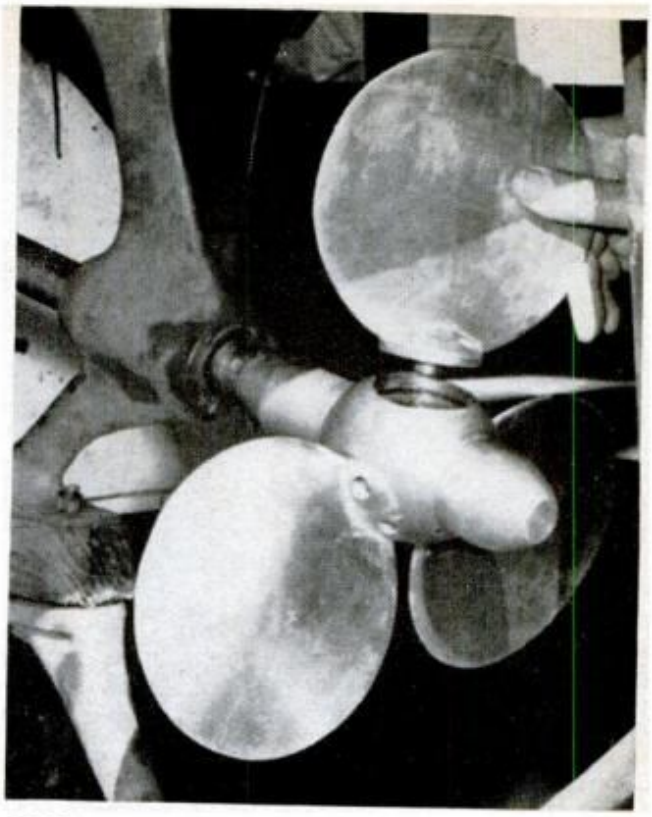
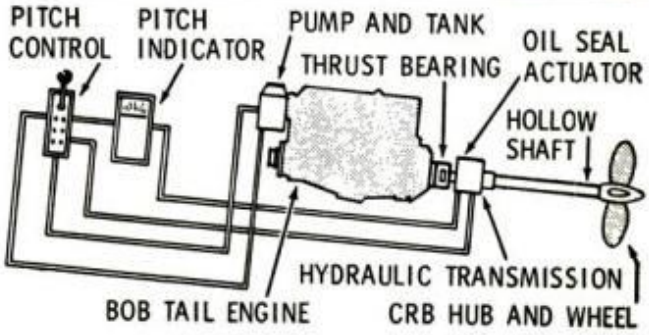
Reversible Prop

Controllable reversible-pitch propellers, formerly practical only on large vessels because of size and complexity, can now be used on small pleasure cruisers. The new Amplitorque CRP propeller system offers precise pitch control from the cockpit through a hydraulic system, eliminating the need for a clutch and reverse gear, and is described by the manufacturer as a design of "bedrock simplicity." Available to fit shaft sizes from 1 to 3 inches and wheel sizes from 12 inches to 40 inches, it's aimed at the $10,000-and-up cruiser market and is made by Amplitorque Propellers Corp., 1646 Beaver Dam Rd., Point Pleasant, N. J.





Missile Drilling

Using a 60-foot crane and 16-foot bits, huge drills are excavating holes for housing *Minuteman* missiles underground in Montana.

The underground sites will hold the intercontinental missiles ready to fire with only a short notice. The sites are spread throughout the United States, and include *Atlas* and *Titan* missiles as well as the solid-fueled Minuteman. The record for drilling one of these holes is eight hours.

The holes are usually 60 feet deep.

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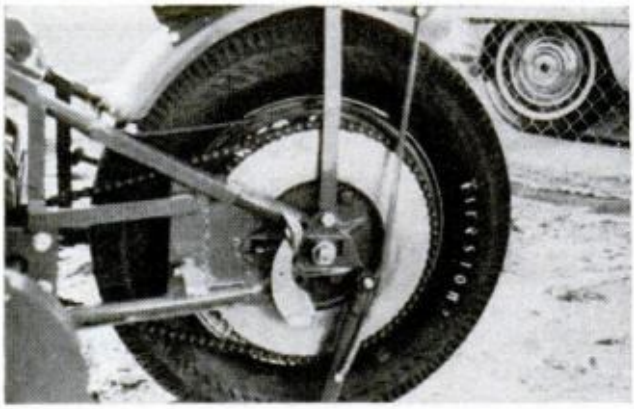
TRANSVERSELY MOUNTED Chev V8 adds rigidity to spindly frame. Alcohol-and-ether fuel blend helps cycle reach up to 160.64 mph in quarter mile



REAR-WHEEL BRAKE PEDAL, just aft of footrest peg, is operated with heel. Tire traction is a problem —even though driver sits directly over rear wheel

I Hit the Ground at 150 MPH

By E. J. Potter
as told to John E. Boykin

THE REAR WHEEL was raised on the kick-stand, spinning wildly, and the Chev V8 screamed as I waited on the starting line. *Bloody Mary,* my drag 'cycle, has no gears; she runs in direct drive, so I start off the kickstand.

Green light! I kicked away the stand and 600 churning horses hit the asphalt. The screeching tire spewed white smoke.

I always feel as if I'm creeping off the starting line, but viewers say it looks like I've been shot from a cannon. I had made many such takeoffs in *Bloody Mary I* and *II,* and I had no reason to expect this run to be any different.

In less than 10 seconds I flashed across the finish, a quarter of a mile away. Mary's rear tire was still smoking, but by now she was getting enough traction to do a "wheelie"—to lift the front wheel off the

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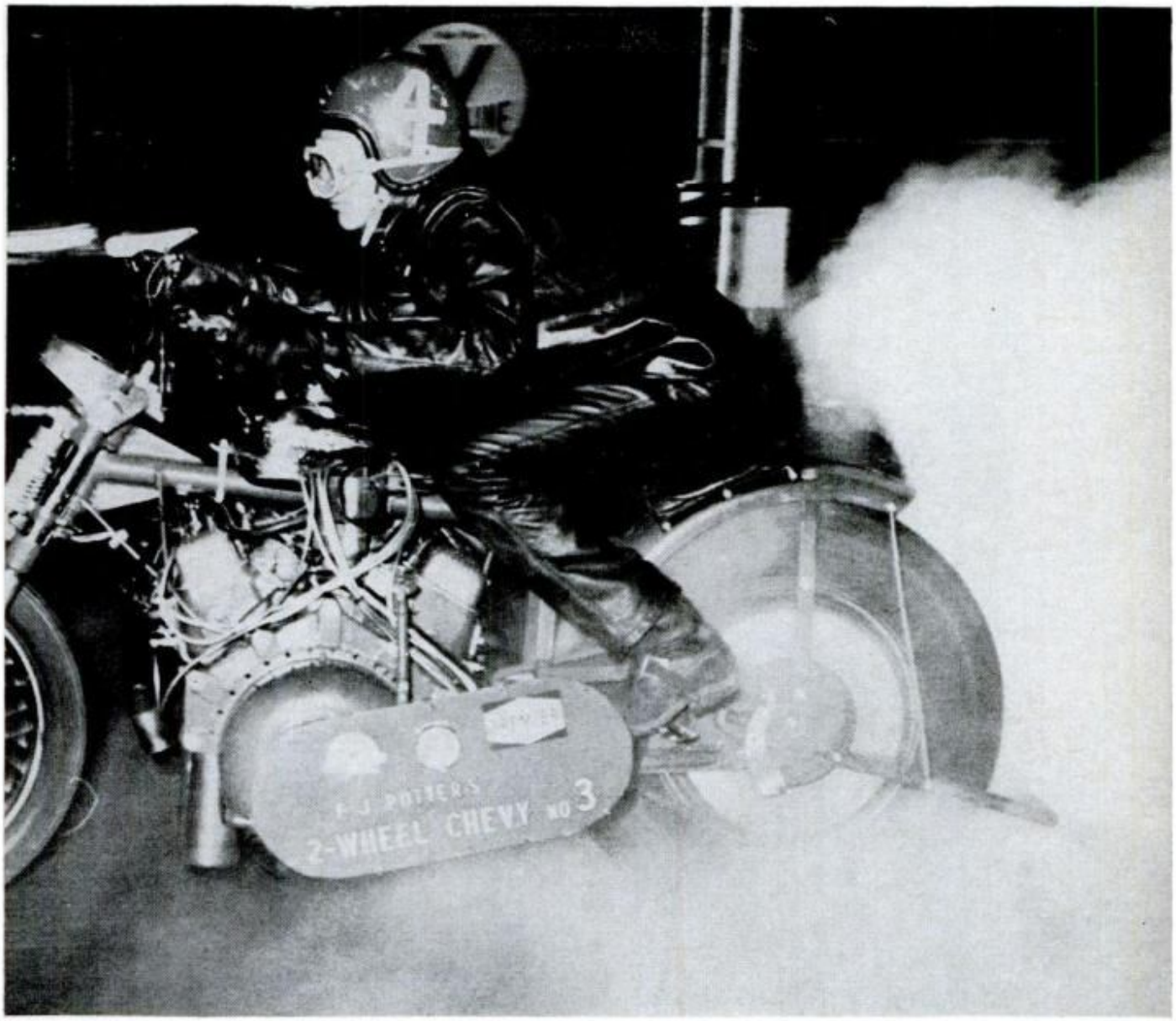

ground. Past the timing traps, I leaned forward to get the wheel back on the ground, closed the throttle and hit the ignition-kill button.

Nothing happened! The throttle was stuck and, though the spark was shut off, the overheated engine greedily gulped the ether-alcohol fuel and gained speed. I was doing 160 by the time I hit the brakes. The rear wheel had an automobile drum brake and the front wheel had dual heavy-duty motocycle brakes, but the V8's torque was too much for the linings. They rubbed off only about 10 mph before they disintegrated. I was astride a two-wheel tornado that was hell-bent on self-destruction.

I hung on as we ran out of pavement and roared into a field about 200 yards wide. A small bump launched us into the air, but we landed smoothly. Then I noticed the woods at the end of the field zooming toward me.

The engine never faltered, so I knew I hadn't slowed at all. But regardless of speed, I had to abandon ship. I lifted my

(Please turn to page 220)

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BAG IT

By Fred Bear

World Renowned
Bowhunter

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Boars, bears, tigers and elephant—for real thrills and the most exciting trophies I do it the way the Indians did it

THIS WAS THE SUPREME MOMENT. You can hunt all your life with a bow and arrow, but you're never really prepared to face the greatest of all wild game. I had come all the way from Grayling, Mich. to Mozambique in Portuguese East Africa, and I was finally nocking the arrow for the big one. Four tons of bull elephant started moving out across the clearing about 40 yards away. I stepped from behind my cover; the bull turned to look at me. I sighted and let fly. It was a killing shot, but the elephant ran. For a moment I thought I might have misjudged the power of the bow, and we would have to track the wounded elephant with rifles. But then, before he was out of sight, he dropped to his knees, then crashed to the ground.

A perfect trophy with a single arrow. I was feeling mighty proud of that shot—not so much for my skill as a bowman, but because I had proven once again that no matter the size of the game, you can bag it with a bow.

Like every hunter I had always dreamed of going after big game. Unlike most, I've been lucky enough to sight an arrow on record-size grizzly, tiger and wild boar. But after hunting all over the world I've learned that the most demanding and challenging game for the bow hunter is right at home—the elusive whitetail deer.

WITH A BOW

If you can stalk and bring down an old buck, you can hunt anything with skill. It takes dedication to develop your skill as a bow hunter, but if you're willing to practice and follow step-by-step procedure, anyone can put William Tell to shame. And while you're learning, you'll also be enjoying an exciting and satisfying sport.

Select a bow that you can handle easily. For the novice, the best guide is to buy a bow that you can hold at full draw for ten seconds. Archery muscles develop quickly so a slight tremor is all right. If you shake, however, the bow is too heavy. Practice a half hour a day for about two weeks and you'll be able to handle it with ease. A bow weight of about 35 pounds draw weight should be about right for the average man.

Match your arrow to your bow weight. If properly matched, the arrow snakes around the bow when it is shot. Stiffness or spine is a most important factor in this fitting. You will note that most arrows are graded as to the size bow they will fit.

To determine your proper arrow length, place a yardstick against your chest between your arms. Extend arms horizontally along the yardstick and note the distance to the ends of your fingers. This is your correct arrow length for starting. Hunting arrows should be an inch longer to the back of the head.

As you become more proficient, the hunting instinct will come to the fore. This usually means selecting a heavier bow. Men should use at least a 45-pound bow for hunting big game. This means extra practice, for the most part, but the physique to handle

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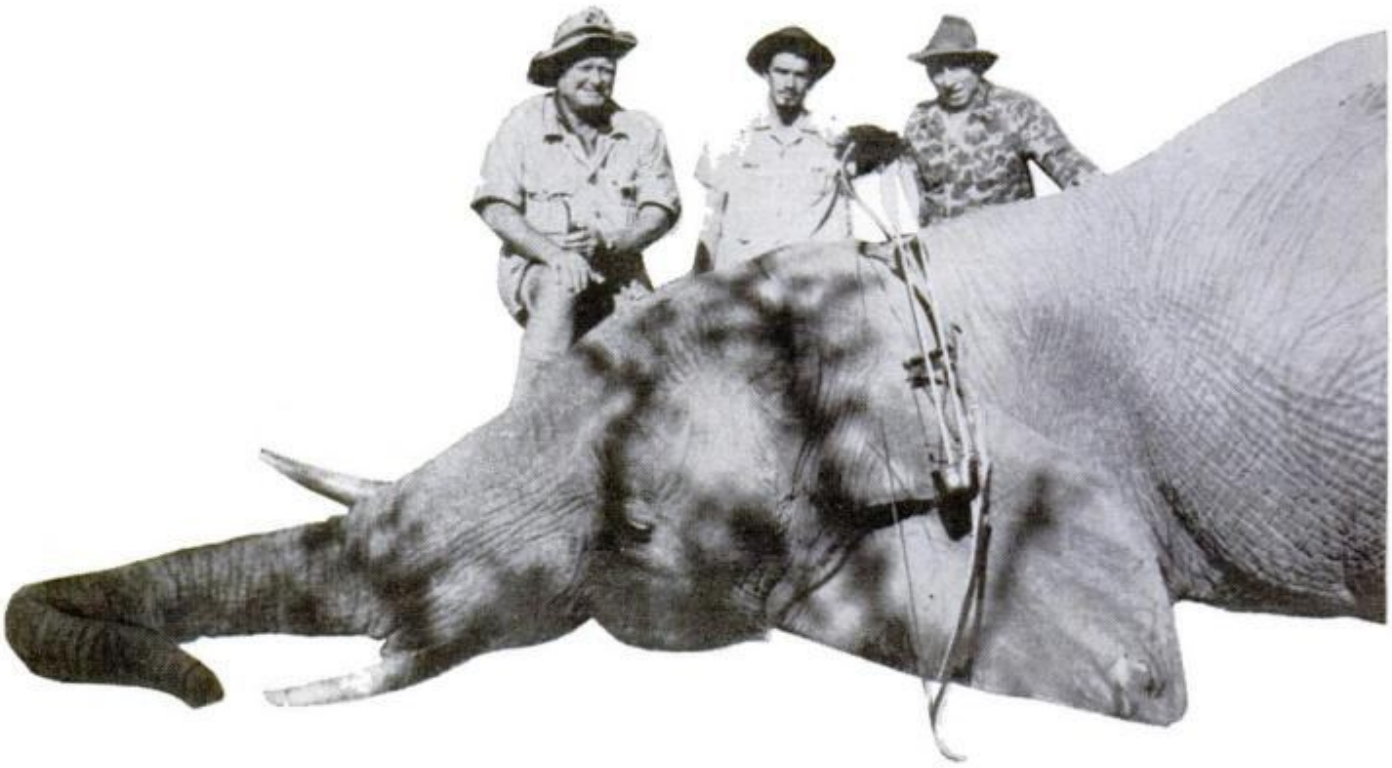
STALK AGAINST THE WIND at all times. In early morning and evening the wind moves down, so stalk from the heights, quartering the wind and moving carefully behind and around the cover until close enough to shoot

this weight can be easily developed. You can shoot a 40-pound bow for years and not be able to handle a 50 pounder. The muscles must be developed by shooting a heavier bow.

Once you have a bow of the proper hunting weight, begin practicing each day. Shoot until you can hold the bow at full draw no longer. Each day you practice, note that you will be able to shoot a few more arrows. Keep at it.

Perseverance will enable you to easily handle this heavier bow. You may then want to develop your muscles to still heavier bows. The average hunting bow is 50 to 55 pounds draw weight. This is the weight that should be used for game the size of deer. For larger game such as moose, a weight of 60 to 65 pounds is recommended.

In building your muscles to heavier bow weights, care must be taken to avoid becoming a "snapshooter." This affliction is one that creeps upon you when shooting



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CORRECT ARROW LENGTH is important to hunting. Hold a yardstick against the chest with arms extended; where fingers meet is length arrow required

UNIFORM PULL is demonstrated by the author. One finger touches the corner of his mouth to insure that every arrow is released with the same power

heavier bows. Muscles are built up by breaking them down. This is the progressive weight-lifting process.

Shoot only until your muscles are tired and then do not shoot again for 24 hours. If you continue to try to shoot beyond this tiring period you will find yourself not coming to full draw and well on your way to becoming this snapshooter. A snapshooter is one who cannot come to full draw. He loses the arrow before drawing it to full length. It is not likely that he will ever become a good shot.

ULTIMATE THRILL for the bowhunter. Fred Bear (right) brought this bull elephant down with a single arrow during a hunting safari in East Africa

Stalking Your Quarry

Stalking is an art many of our younger hunters know little about. With the scope-sighted rifles, the hunter doesn't have to get as close as he previously did. Modern day archers, many of whom once carried a rifle, have to re-educate themselves in the ways of hunting. For the average bowhunter, 35 yards is about the limit for accurate shooting. It boils down to this—if the archer wishes to be consistently successful, he must either sit on his duff in a blind and wait 'em out, or he must learn how to stalk.

Almost every animal has some defect in his makeup which may be turned to the hunter's advantage. I have learned that anyone who can successfully stalk whitetail deer can be successful on any other big game animal. So further observations will be more-or-less directed toward outwitting this clever species.

The object of stalking is to get as close to the animal as possible before shooting. You've got to think like a deer in order to get close to him. A whitetail is trained from birth to hide, camouflage, and creep away from noise and scent. Yet he has courage enough to lie motionless and let a hunter pass by him if he thinks he can escape detection. Deer have three principal faculties for detecting the presence of their enemies—nose, eyes and ears. The sense of smell is by far the most im-

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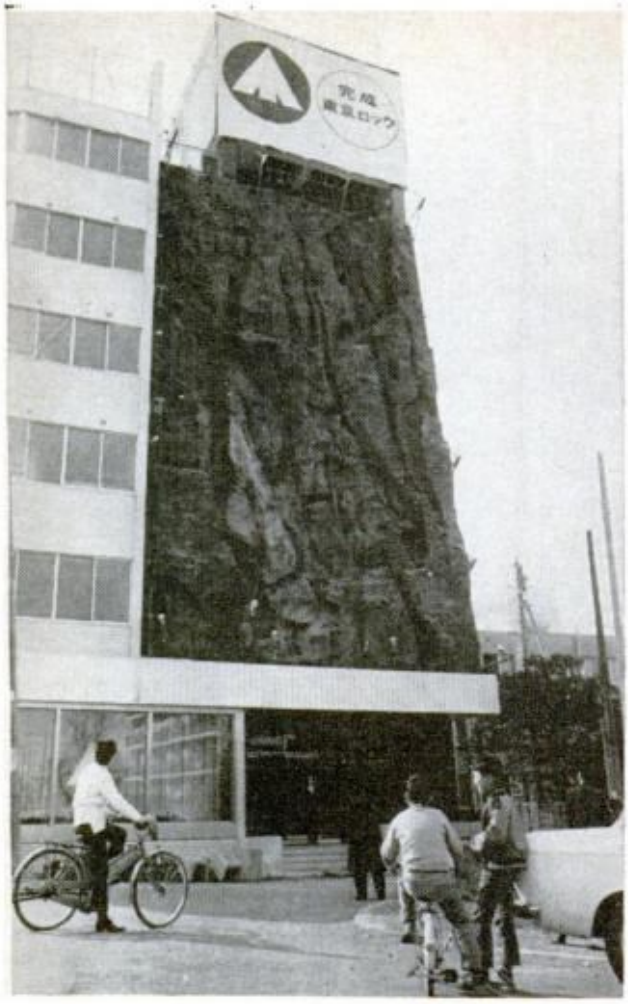

A Yen to Climb

Designed as a training area for mountaineers and beginners, a six-story artificial mountain has been built in the center of Tokyo. Although limited in area, the mountain offers the technical challenge found on a major rock face.

Electronic Fire Locator

An electronic billboard, the only one of its kind, will pinpoint location of a fire in the new Los Angeles Music Center, should one ever break out. Firemen would check the board and head for the fire.

Pictures by Phonograph

Play this special 12-inch LP Phonovid record and it delivers still pictures, voice and music all at the same time. Westinghouse process puts 400 pictures and 40 minutes of sound on the Video-disc.

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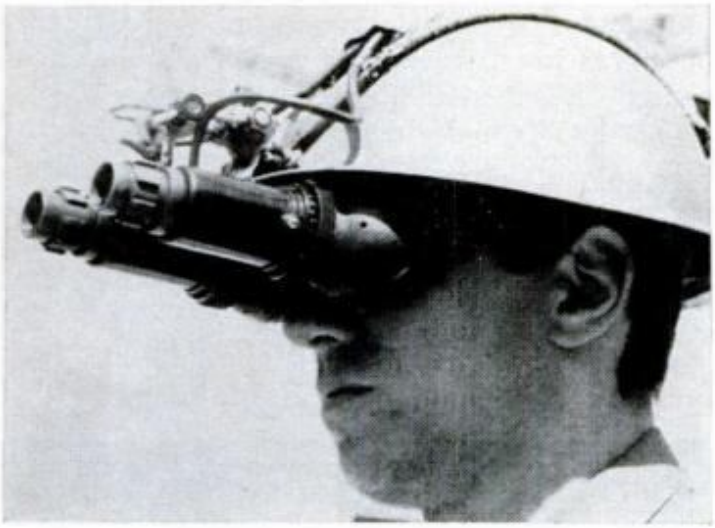
Night Watch

What looks like a pair of binoculars is actually a new infrared transmitter and receiver system developed by the British for night-time communications. It was produced in the Ministry of Aviation's Signals Research Center.

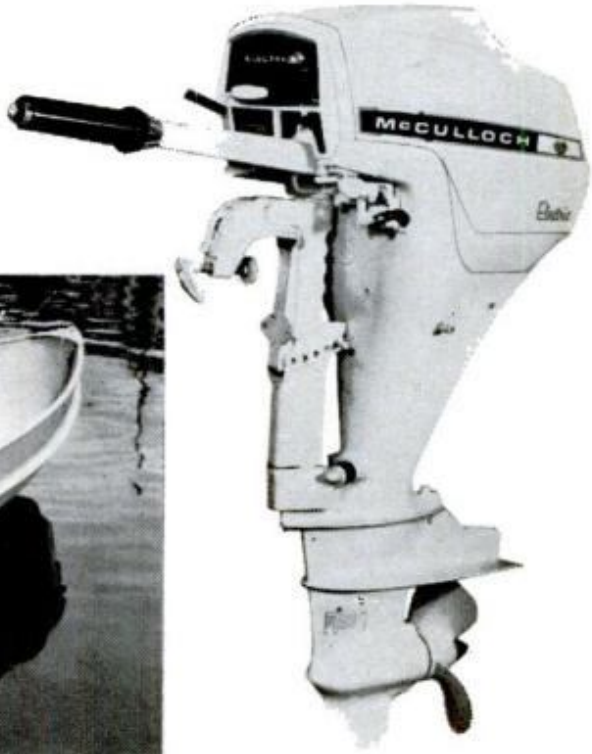


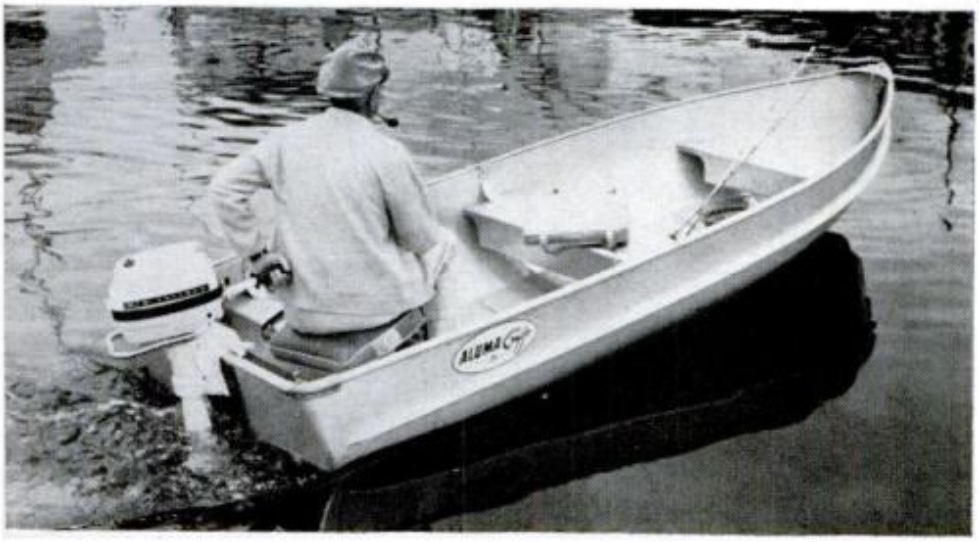
Like Walking on the Moon

Wearing a rig that simulates the one-sixth gravity found on the moon, a National Aeronautics and Space Administration engineer climbs out of a "crater" in a lunar simulation area near Houston, Tex. He's carrying a Jacob's staff to aid walking.

Two New Motors from McCulloch

After dropping its 3½-hp fishing motor a year ago, McCulloch is introducing a 37-pound air-cooled 4-hp outboard, below, based on that famous chain-saw engine. Also new is an electric-start model of the 7½, right.





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Home Brew:

ARTIST SHELDON FINK is a perfectionist. When he couldn't find a commercial paper that met his standards—he wanted "a superior quality linen paper" for his etchings—he decided to make his own.

Luckily for him, he lives and works in an area—northwestern Massachusetts—where Yankee ingenuity still exists. Royall Moore, a local carpenter, is an inventive Yankee. Having once made his own paper

PARTNERS in papermaking: Sheldon Fink (left) and Royall Moore. This is the start of the process, the weighing of cotton and linen cuttings for pulp

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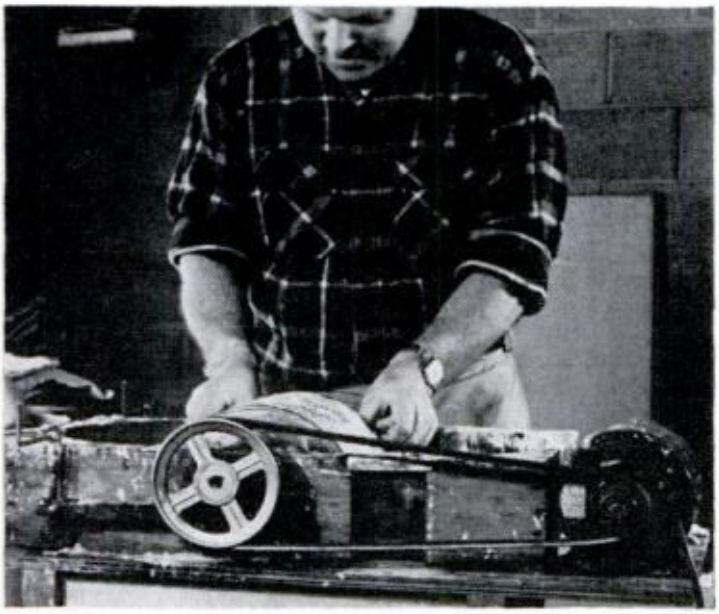
Fine Paper from a Tub

for Christmas cards, he became interested in the project.

Moore built all of the equipment, including an authentic replica of a type of pulp beater that's been used for papermaking since the 17th century. He set up shop in his basement.

Research and experimentation resulted in what the two artisans considered the product with the best balance of linen and cotton.

Early in the game, they sacrificed Mrs. Moore's linen tablecloths for the cause. They also got linen pulp from a local mill that produces paper used for U.S. currency. But when they came back for more, they were politely turned down. The owners of the mill, it turned out, were concerned about the possibility of the linen pulp being used by counterfeiters. Now Fink gets all the linen he needs from a mail-order house.—*Lucien Aigner*



COVER IS SLIPPED over the drum of beater where the mix of water, cotton and linen is turned into pulp. Rebuilt electric motor makes the job easier

SINGLE SHEET is formed by layer of pulp on mold (shown being taken out of tub on other page). Here, the soggy sheet is dropped onto a piece of blanket

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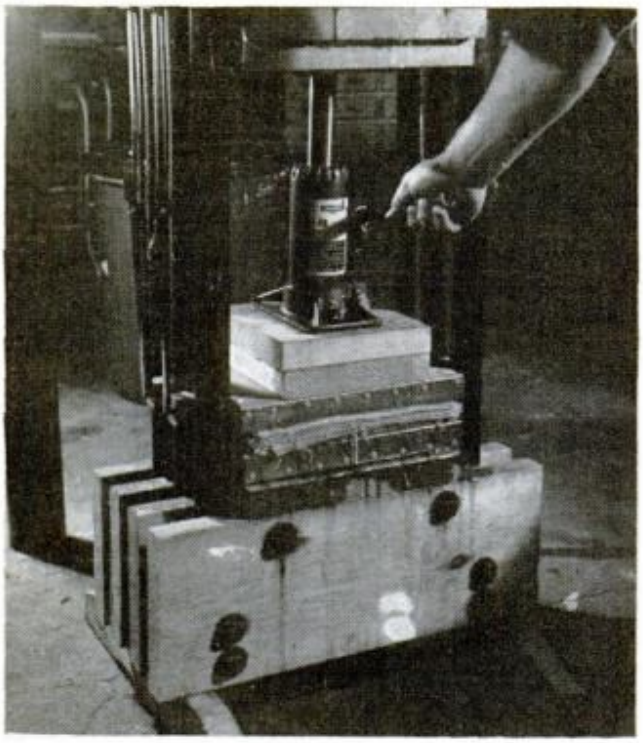
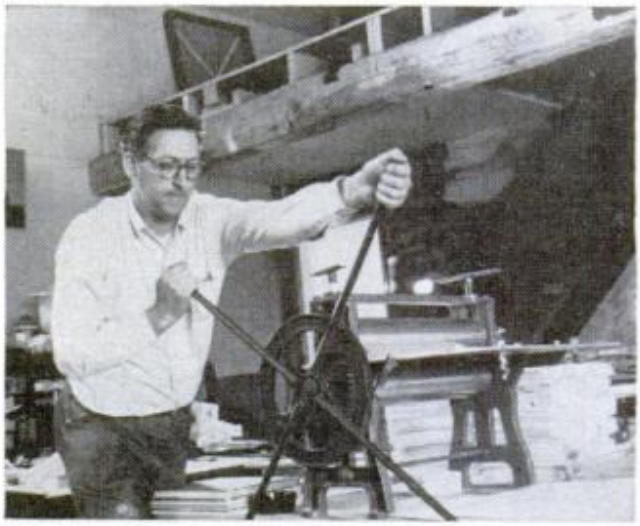
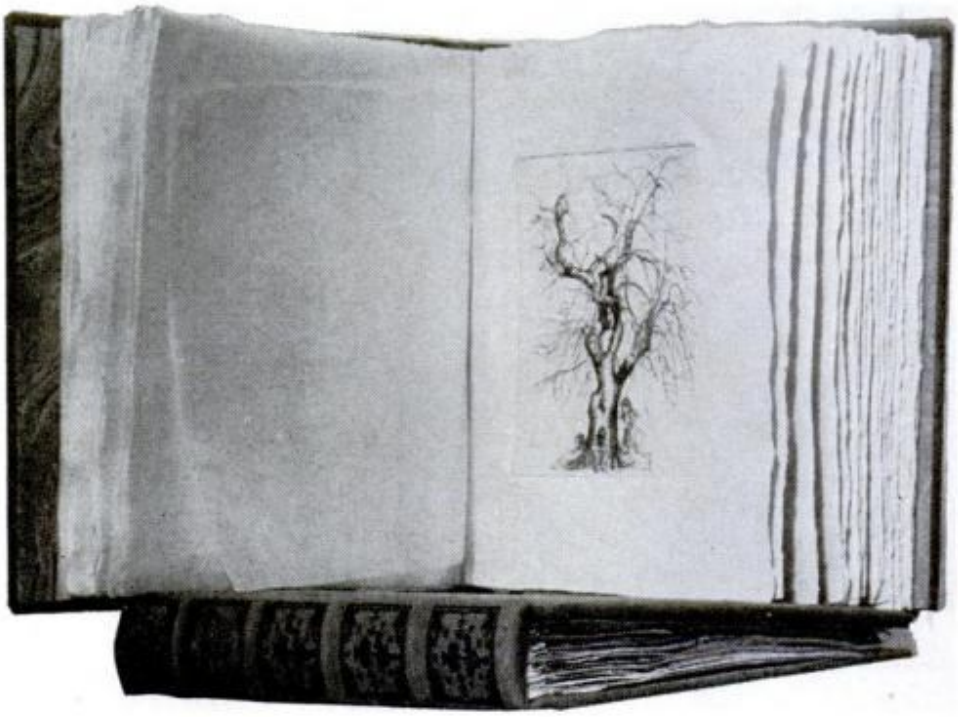
WET SHEETS are carefully sandwiched between absorbent pieces of blanket. Layers are built up into a stack, called a "post," that's several inches thick. The post is put into hydraulic press





THE RESOURCEFUL MOORE made the hydraulic press (left) from a truck jack, heavy wooden blocks and sections of galvanized pipe. Most of the excess water is squeezed out in this operation and the product is close to finished form. All that remains is a final drying procedure. That's done on a second press (above) that the artist has in his studio

HANDSOME volumes of etchings, hand-bound in deerskin, are the final result of Fink's art. He has sold six volumes, two of them going to art museums



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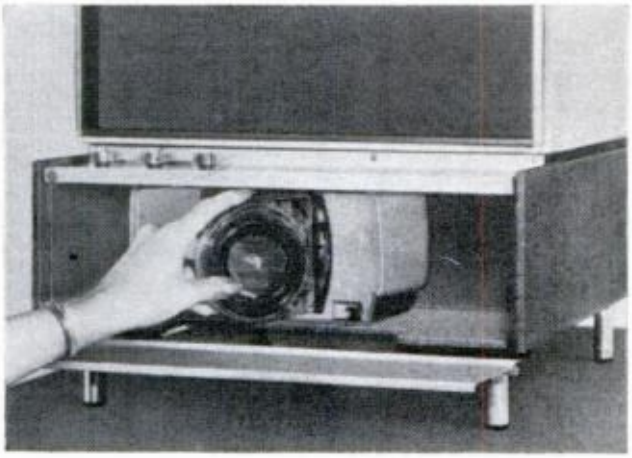
Bright Light

Fifty times more intense than an auto headlamp, the Astrolux High Intensity Light can bathe a 200-foot city block in daylight-bright light. It's ideal for police and rescue work.

The unit weighs 13 pounds, has pistol-grip controls and is air-cooled. It can be run from a standard 110-volt outlet or a car generator. The light is distributed by Karl Heitz, Inc., New York, New York.



Cartridge Loader

Five-second loading is a feature of an 8-mm projector inside a small cabinet that projects onto a built-in screen for daylight viewing.

Engineers at the Technicolor Corporation used a unique three-mirror system for the projected image. This gives the effect of a long projection throw—a big image, despite the small housing.

The Model 600 console viewer was specifically designed as a classroom "teaching machine." More than 1600 instructional films have been prepared.

No threading or rewinding is required. In fact, even a first-grader can load the cartridge and flash the image on the screen in less than five seconds. The projector can run up to 50 feet of film at a time. Cost is $199.50.

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BALLS O' FIRE!

PM Tracks Down

A bobbing, dancing light, it the sky, then mysteriously "explain" it, but what is the

By Robert Gannon

ON A LONELY GRAVEL ROAD in the Ozark foothills nine miles south of Joplin, Mo., an eerie light shines almost every night. Sometimes it looks like a lantern far in the distance, carried by someone slowly walking. At other times it appears to be a ball of fire hurtling at the viewer with incredible speed—only to stop, skip around near treetop level, then zoom back into the distance. Occasionally, so I was told, it settles on the hood of your car, or dances off a little into the woods or disappears, then reappears behind you.

To verify the tales told of the mysterious Ozark Spooklight, I phoned the Joplin *Globe*, state officials in Springfield, and residents of Hornet, Mo., the nearest village. Everyone agrees there is a strange light on Spooklight Road. But nobody is certain what causes it.

Some believe the light is simply a ghost, or as they say in the area, "ha'nt." Most popular tale is of a miner whose children

SPOOKLIGHT ROAD looks like any other country road by day. The author observed the light from this spot

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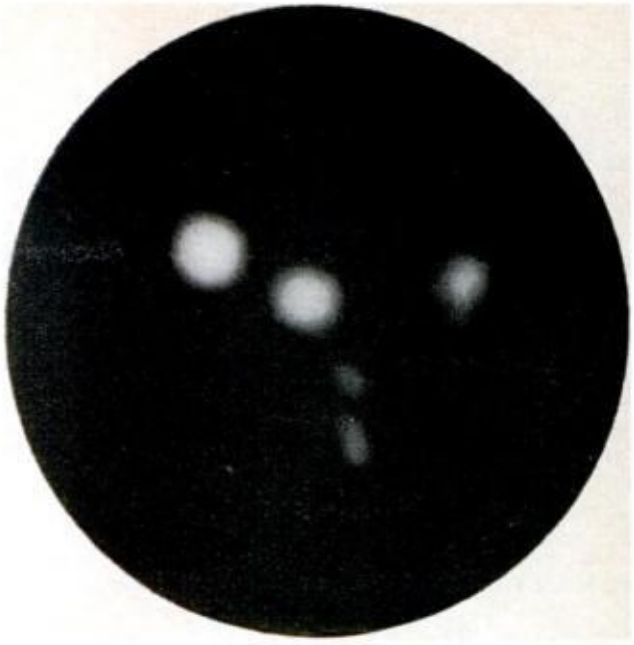
Ozark Spooklight

rises out of the night, grows in
disappears. Local legends
truth about the eerie Spooklight?



TELEPHOTO LENS on camera brings the Spooklight closer, showing that it's several distinct lights

were stolen by Indians. With his lantern he set out to look for them, but was never seen again. Spooklight is his lantern.

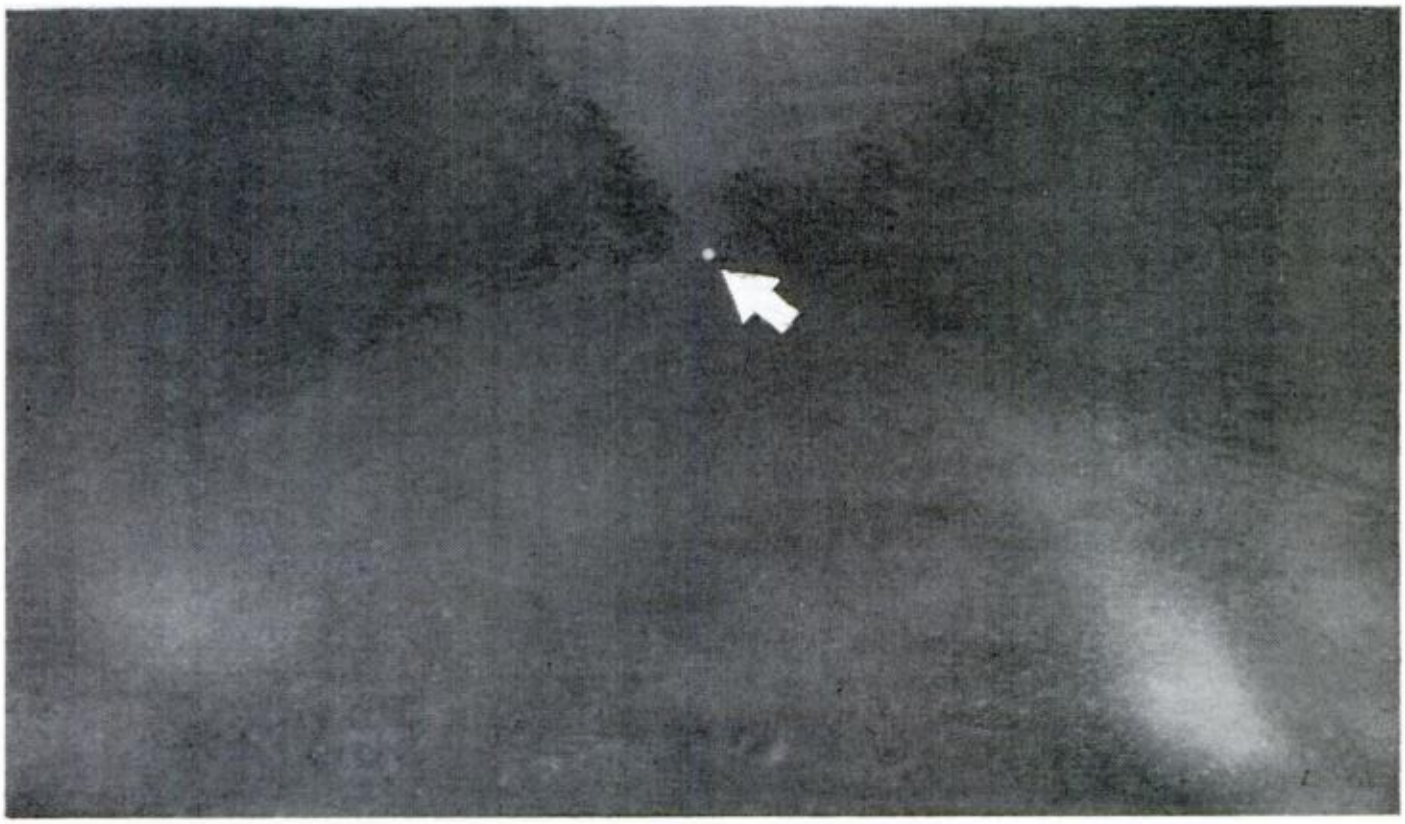
Others believe the light is will-o'-the-wisp, or "glowing minerals," or static electricity, or merely a farm light somewhere in the distance.

But all the theories seemed to have holes in them. Now *PM* was sending me for a personal look.

It was just after midnight in early summer when I stopped in a diner—not far from the spot where Missouri, Kansas, and Oklahoma meet—to get directions. "You'll never find that light," volunteered Clark Fryatt, a florist from Senica, Mo. "I'll go along with you. I always like to see it."

On the way Fryatt told me that Spooklight (everyone seems to capitalize it) has been there as long as he can remember, is "somewhere around" every night unless

PHOTOGRAPHED from the center of the road, the Spooklight is visible in the distance, just above the road



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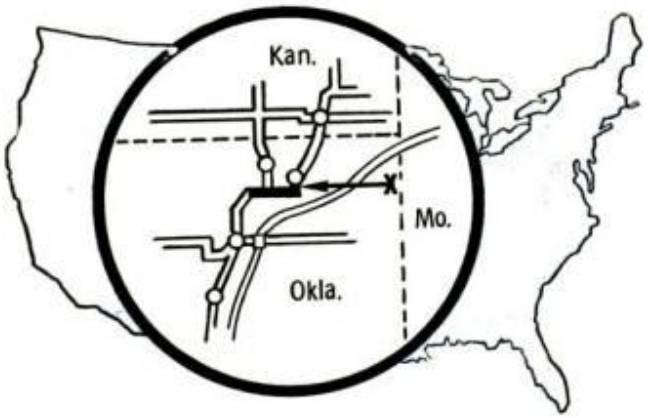

SPOOKVILLE is shown on this map inset. The "X" indicates Spooklight Road and the arrow points in line to Rt. 66, giving credence to author's theory

a dense fog settles in the hills. He also said that he doesn't believe any of the theories he's heard about its origin. He won't say what he does believe.

We left US 43 and passed through the one-store town of Hornet, edged cautiously through Fivemile Creek where it splashes across the road, drove four miles southwest, and turned from Stateline Road onto a narrow east-west lane. "You're in Oklahoma, now," said Fryatt, "and this is it—Spooklight Road."

He was whispering. I noticed that I was, too. "Turn off your lights," he suggested. "It's best to drive slowly in the dark." He locked his door.

The tepid night was still as a tomb except for an occasional lonely whippoorwill and, believe it or not, a hound baying in the distance. There was no moon. Although I could see the general outline of the road—so straight it converged to a point in the distance—every so often I'd get too near the shoulder, and a blackjack oak branch would screech eerily along the side of the car.

"Look!" said Fryatt suddenly, in a strained voice. Ahead of us a golden light flashed into view, as though someone a half mile away had switched on a reading lamp. It seemed to jiggle, to wobble back and forth, diminishing and brightening. When I let myself, I could imagine it was rushing at me, then quickly receding. It *did* look like a ball of fire; the edges were blurred and constantly changing. We could see its reflection in the car hood.

It jiggled around for a few minutes, then blinked out. "I hear that if you look at it through binoculars, it sometimes seems to break up," said Fryatt. "Usually it stays lit for hours."

A few minutes later the light appeared again, exactly as before, down at the end of that canyon of trees. I started my stopwatch. The light shimmered for four minutes, 20 seconds, then disappeared again.

"Can you see the light from any other location?" I asked my guide.

"They say you used to be able to, but not any more."

So that scrapped my first idea—triangulation with a transit. I'd have only one leg of the triangle to work with.

We watched for a half hour or so, and I noticed that the light never glimmered for less than about five minutes, but that the intervals between seeing it varied from a few seconds to 10 minutes or so.

We drove slowly ahead, and the car undulated over the road. We saw the lights only when we were on the crests. On the last hill, before the lane turned sharply

TAPING CELLOPHANE over headlights, University of Arkansas instructor Jean Prideaux prepares for the PM experiment that solved the mystery of the light

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south, the trees thinned out, and far in the distance we could see a tiny village—Quapaw, Oklahoma, Fryatt informed me.

Was Spooklight simply one of the village lights? It seemed logical. But then why did it seem to move? Why was it that peculiar golden color? Why was it seen only at intervals?

In the daytime, Spooklight Road looked like any other sleepy byway. The few sideboard and fieldstone farmsteads along its 3⅔-mile stretch look somewhat better than one might expect in the Ozark foothills. The only thing that seems singular about the road is its remarkable straightness and the abundance of beer cans along its edges.

Ozark historian Vance Randolf, in *Ozark Superstitions*, says "Some mighty strange people have lived along this road and some very strange things have happened there." Adds Margaret Hager, present administrative librarian of the Joplin public library: "That's a strange group of people over there around Hornet—a very close clan."

According to a story in the *Kansas City Star*, a number of years ago an Indian couple who lived on the road had two little girls who mysteriously died. The Indians blamed the deaths on "the evil influences of the ghostly light." So they moved away.

Most of the people who live along the road today hesitate to talk with outsiders. You walk up the path and hear a radio blaring in the kitchen, but nobody answers the door.

One who did answer, however, was Helen Logan, an ample woman who claimed she not only lacked an opinion of the light, but didn't care to develop one. Sweeping her arm toward the horizon, she said, "Maybe it's something over on the far hill," and indicated I should continue my investigation there.

Finding the cause of Spooklight isn't helped either by those who have a vested interest in it. Spooky Meadows, for instance. He runs what he calls The Spookville Community Building and Museum—a tourist trap that doesn't quite make it. The building—about the size of a double garage—squats at the east end of Spooklight Road. Inside, local teenagers play juke box and pinball machines, guzzle pop and polish sausages, and sprawl on

(Please turn to page 207)

CENTER OF SPOOKVILLE is the museum and lunch room catering to tourists. The author (right) talks with Warren Harmon, an expert on the local legend

SPOOKY MEADOWS, owner and promoter of Spookville, refused to believe the PM explanation. He contends light was seen in 1866, long before the auto

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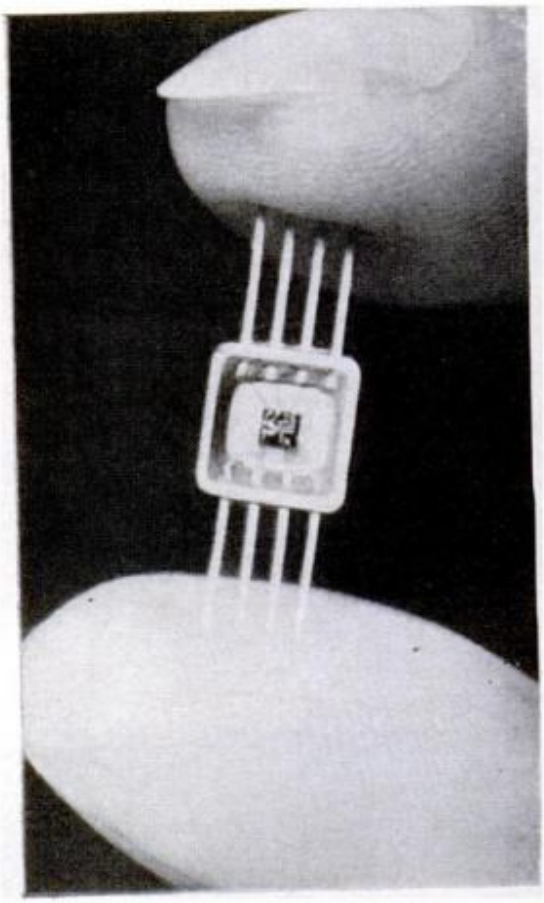
Miniature World of Microcircuits

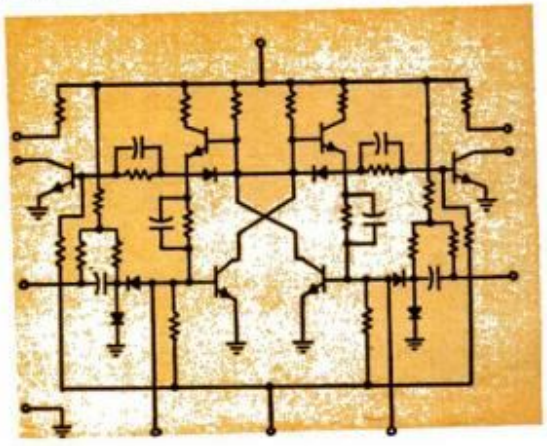
You don't need a magnifier to find your transistor radio. But as new trends to smaller circuits continue to grow, you soon may

By James R. Berry

TEENY CB RADIO has earpiece buried in one end; must be held up to your ear to be heard. Other little package is the battery pack and on-off switch to control and power the set



COMPACT POCKET OR PURSE-SIZE PORTABLE TV gives an idea of what RCA is trying for. Miniature set is not in production today, but neither is it too far around the corner



NAKED MICROCIRCUIT reveals miniature size of these devices. The schematic shows just how many electronic parts it replaces

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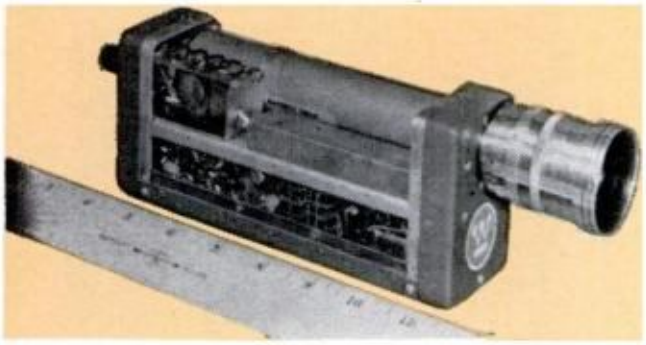
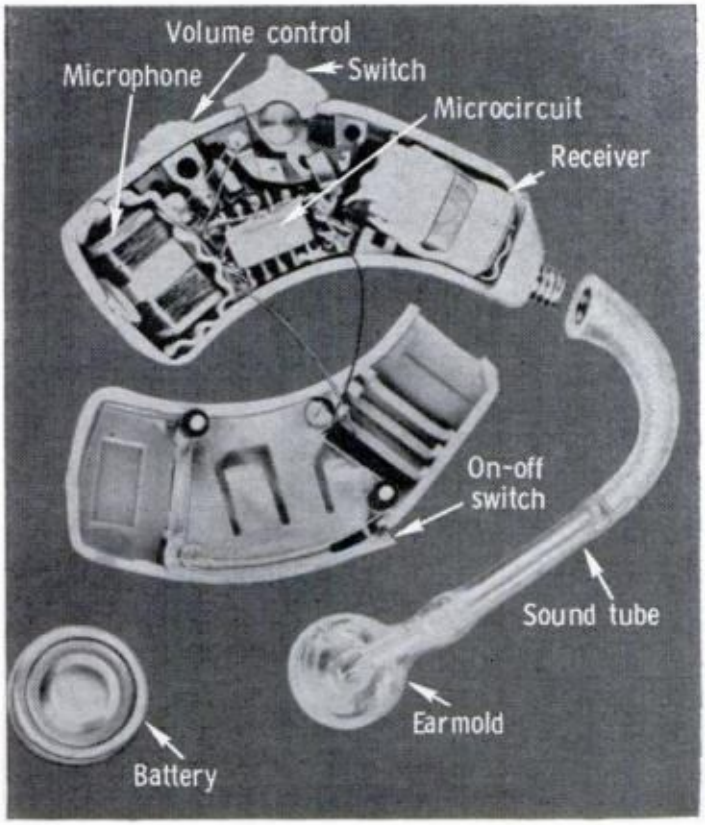
"YOU HOLD ONE SIDE to your ear," said Westinghouse engineer Glenn Skouskon as he handed me a citizens band receiver about the size and shape of three bouillon cubes laid in a row. An antenna the length of a toothpick stuck out from one end. A wire—like an umbilical cord—led from a plug alongside the antenna to a power pack slightly larger than the receiver itself. At the radio's other end was a small hole. I put it close to my ear.

"You're at the Westinghouse Defense and Space Center in Baltimore receiving on a 30-megacycle citizens band. Can you hear?" The words crackled from the hole as someone on the staff broadcast from a CB transmitter a few offices away. After listening to a few more sentences, I gingerly handed Skouskon the receiver. He put it and its six-volt battery into a plas-

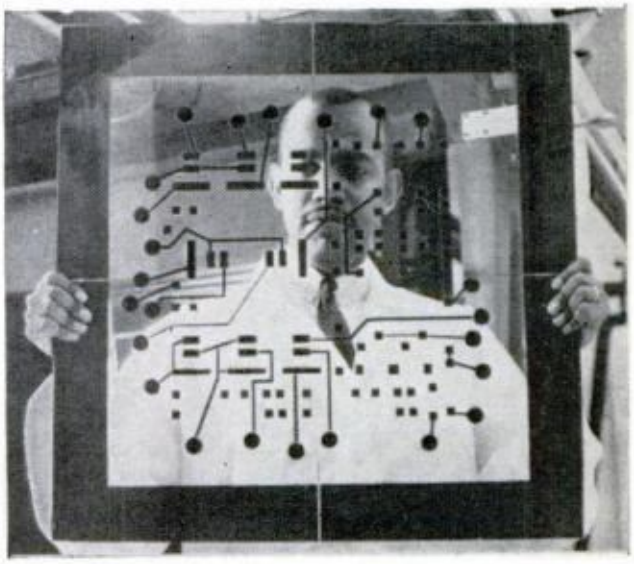


MOLECULARIZED TELEVISION CAMERA for space and military applications may someday replace your 8-mm camera. It's made by Westinghouse



MICROCIRCUIT HEARING AID is first consumer product to make use of integrated circuits. Zenith unit sits behind the ear, affords high degree of amplification

MOLECULAR AMPLIFIER is important part of aerospace radar and communications systems. The device is made up of several independent integrated circuits



MASKING PLATE is vital part of making integrated circuits. It is photographically reduced 200 times before it becomes a circuit for an airborne computer

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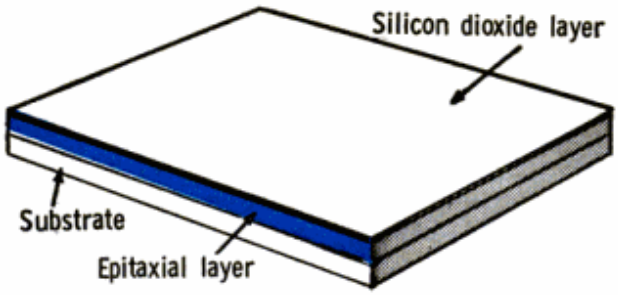
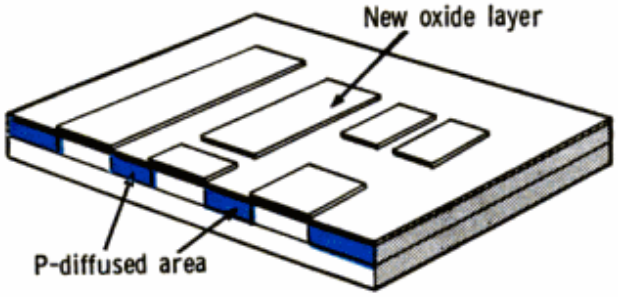
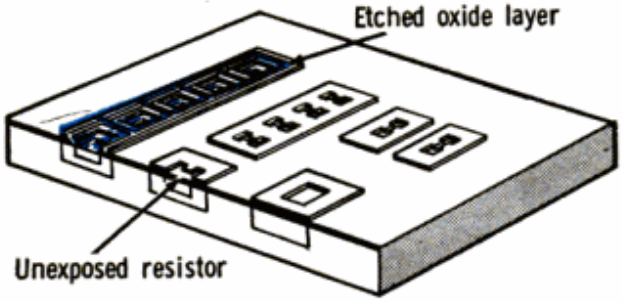


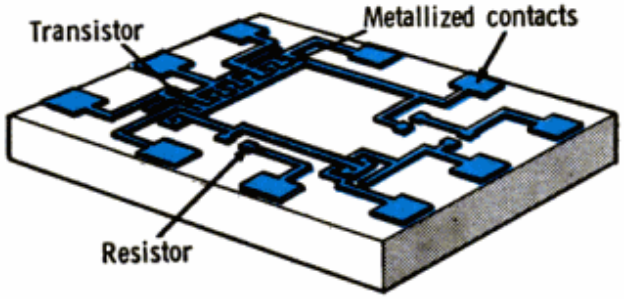
EPITAXIAL WAFER. Layer of N-type silicon is grown on P-type base. This provides PN junction where layers join. Surface is then coated with glass. N-type area becomes part of transistors, diodes, capacitors



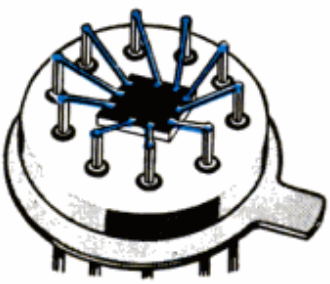
FIRST DIFFUSION. After isolation masking, P-type impurity is diffused into exposed areas. These isolated areas make possible later deposits of other elements while preventing unwanted connections between them



CROSSOVER MASKING. After another masking and diffusion step another oxide coating is selectively etched. This procedure will result in sealing in resistors formed in the preceding diffusion step



METALLIZATION. After still another diffusion and masking, a metal coating is evaporated over entire surface, then carefully etched to leave pattern of interconnections over all of the circuit elements



WIRE BONDING is last step before encasing integrated circuit. Short leads are bonded from circuit to case lead. Techniques used enable completed circuits to withstand severe acceleration, shock and vibration

tic case no longer than a cuff-link box.

The size of this Lilliputian radio is undoubtedly dramatic. More significant, however, is the fact that the receiver's guts are the product of a startling, new electronics technology that, by replacing conventional circuitry with brittle flakes of glistening silicon, is fast making capacitors, tubes, resistors, transistors and wiring as archaic as the crystal set.

Called an integrated circuit, each flake of silicon—thinner than this paper and small as one hole in a window screen—has been doctored so that it is an oscillator, amplifier, mixer, detector: an entire, smoothly functioning electronic circuit.

Just one chip of crystalline silicon can perform the task once assigned to more than 50 separate components and yards of wiring. Yet it consumes a fraction of the power needed by a single transistor. In one instance, a transistorized audio amplifier, consuming one and a half watts, was replaced by an integrated circuit. Power consumption dropped to sixty thousandths of one watt.

Until recently, integrated circuits were too costly for anything other than military, medical or space needs where price is no object for miniaturization, low power consumption and simplicity of operation. But more sophisticated manufacturing processes have steadily lowered prices. Circuits that sold for $400 two short years ago can be picked up for $1 today, making them more economical for consumer use than conventional components.

This drastic price drop is such a recent development that at the time this was written only one common electronic product had made the switch to integrated circuits—a miniature, behind-the-ear hearing aid made by Zenith. But it's generally known that several large manufacturers have zeroed in on late 1965 or early 1966 as the target date for the debut of "home entertainment" products, with crystalline chips replacing most or all usual components. Until these items are publicly released—undoubtedly with a fanfare of publicity—no firm will tell what it has in

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the works. But in the months and years to come, chances are you'll be seeing things like:

• *An ear-plug radio.* You set the dials —probably small, buttonlike affairs—to your favorite station, then plug the whole radio into your ear. A short antenna would bend around in back. The biggest part of the gadget would be the earphone. The circuitry would take up little more space than a fly speck.

• *A tiny portable record player* ideally suited for the beach or picnic. This item won't take up more space than needed for the motor, turntable and pickup arm. The integrated circuit amplifier will probably be pasted somewhere inside the pickup arm, which could also house the batteries.

• *A complete, high-fidelity stereo amplifier* with circuitry contained in a wristwatch size case. A working model of just such an amplifier has already been demonstrated. Practically, it would have to be big enough to tote dials and switches; say, about the size of a paperback book.

• *A reasonably-priced TV home monitoring system.* Place a TV camera in the nursery or at the front door. A turn of a knob will focus a small TV set—possibly as small as a deck of cards—on whoever is knocking or what the child is doing.

There will be no problem in modifying the TV monitor so it can pick up local TV stations. Since integrated circuits require so little current, such a rig would make a truly economical portable TV receiver that should work for months on a pair of inexpensive batteries.

• *A home TV camera*—for the far future. Shoot the family—eventually in color—as you do with your present movie camera. But now the scenes will be recorded on magnetic tape, not film. An attachment would feed the "film's" signals to your TV set for family viewing.

There's no doubt that these things are possible. Scores of similar electronic devices are already at work in missiles, tracking computers, satellites, and communications equipment. Others are being developed monthly. Westinghouse, for example, recently unveiled a TV camera a mere 7½ inches long and weighing only 27 ounces. Only 36 silicon chips replace handfuls of conventional components. Refinements are expected to halve the size and weight.

Then there's a computer once the proportions of a large refrigerator that, thanks to silicon flakes, now fits in a cigarette case and weighs 10 ounces. And an integrated circuit radio pill that broadcasts details about the digestive tract when swallowed helps doctors diagnose gastrointenstinal ills.

Low-power drain, miniature size and falling costs are hefty reasons why integrated circuits have a bright future. But another advantage—their amazing reliability—eclipses all of these features.

Whether it replaces 5 or 50 components, an integrated circuit retains the same reliability, enormously decreasing chances of individual component failure. Then, most connections are within the crystalline structure, eliminating a major bugaboo of conventional circuitry—broken or badly soldered joints. These factors, plus precision manufacturing methods, render integrated circuits practically indestructible.

In one test, Philco ran a series of these circuits at maximum performance over 12½ million operational hours, equivalent to almost 1500 years of use. Just one failure resulted.

Some of Westinghouse's first prototype circuits, made in the late 1950s, were hooked up in an environmental testing chamber. Despite periodic chilling, heating and vibrating, they've delivered their maximum output 24 hours a day since; and they're still going strong. In another instance, a batch of circuits were fired from a mortar. They all worked normally when recovered.

It all adds up to smaller, less costly, more dependable electronic products for you and me. Soon that pocket radio may be replaced with a pocket TV. And it's all possible with integrated circuits in that miniature world of microcircuits. ★★★

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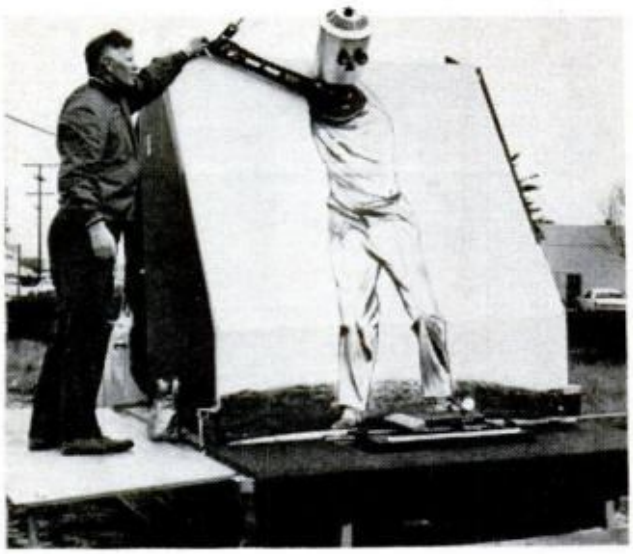


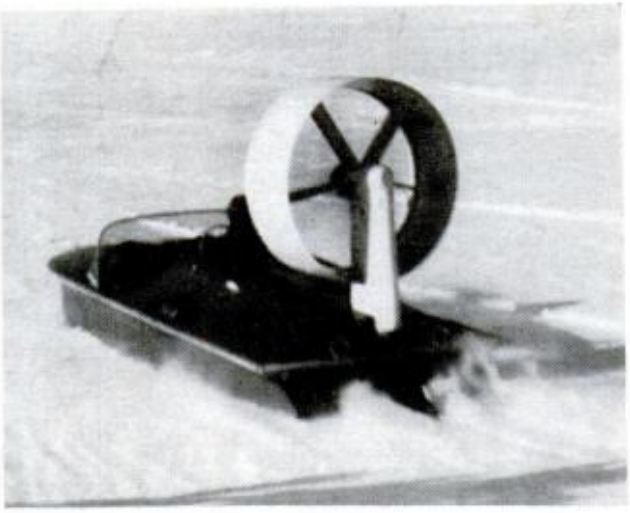
Golfing Robot

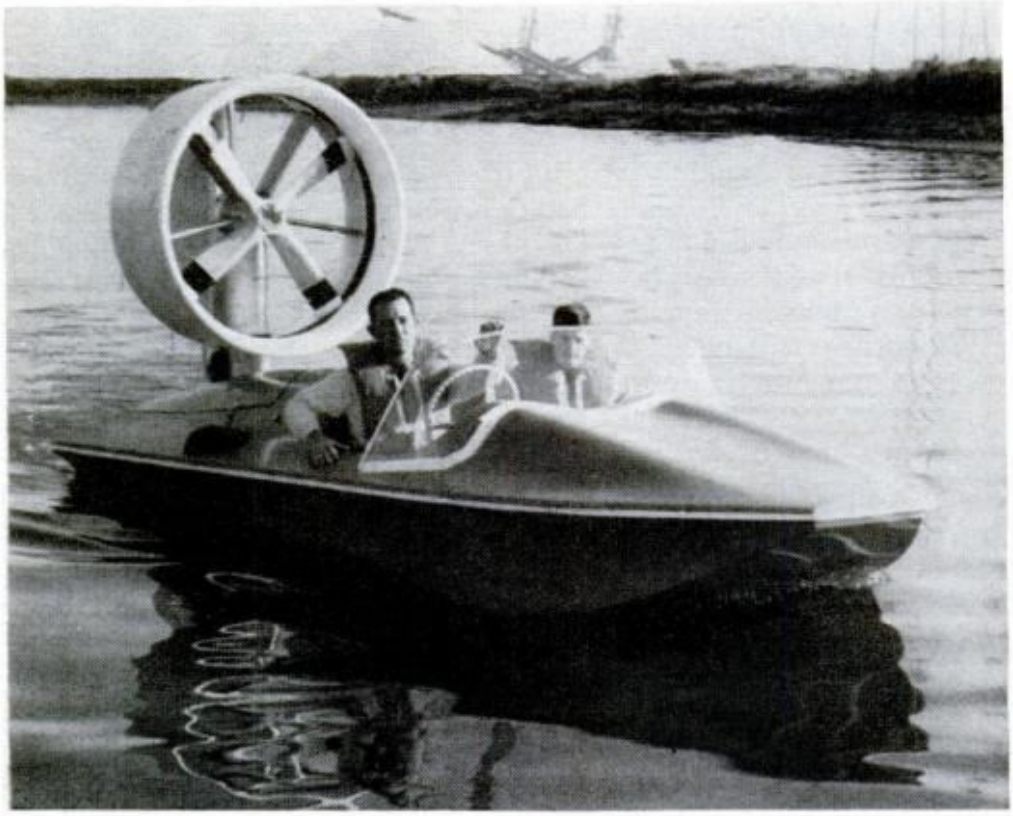
Been hooking or slicing them lately? Digging divots with those iron shots? Don't despair. In time you may get help with your game from a golfing robot named the "monster."

Developed by Golfcraft of Escondido, Cal., it can match a golfer's swing so that custom clubs can be designed to get the most from his game.

Land or Sea Boat

Driven by an air prop, a new fiberglass craft skims over mud, water, snow or ice on built-in runners. Even limited ground travel is possible when it's fitted with small aircraft-type wheels. Called Nordak II, it's made by Aquanautics, Inc., Mountain View, Calif.





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HOME SECTION

43 pages of new ideas

House Inside Itself
This unique all-wood house within a house should last almost indefinitely. And it's not even nailed together.

New Grab Bag of Prefabs
Steel, aluminum, concrete — you name it. They're making handsome prefabricated houses out of just about everything.

New Materials for Quick Remodeling
The job goes much faster when you use time-saving materials. Here are ten of the newest and best.

New for Your Home
The lazier you are, the more you'll like these six new products that take the drudgery out of maintenance.

Leaner Look in Home Building
The home-building industry takes dead aim on rising costs, and the future looks bright for buyers.

Great Hobby Corners in Waste Space
There's bonus space in your closets and corners to make "new" room for hobbies. Here's how.

Wrap Yourself in Quiet
Build silence into your home with the latest methods of sound control.

6 Ways to Put Crawl Space to Work
Why clutter up your basement when the crawl space will hold ladders and outsized tools ready for instant use.

3 Smart Light Fixtures
Don't pay a fortune for a custom light fixture. Make a handsome one from a cake plate or an automobile spring.

Solving Home Problems
Nine money-saving ways to beat those annoying little day-to-day maintenance tasks.

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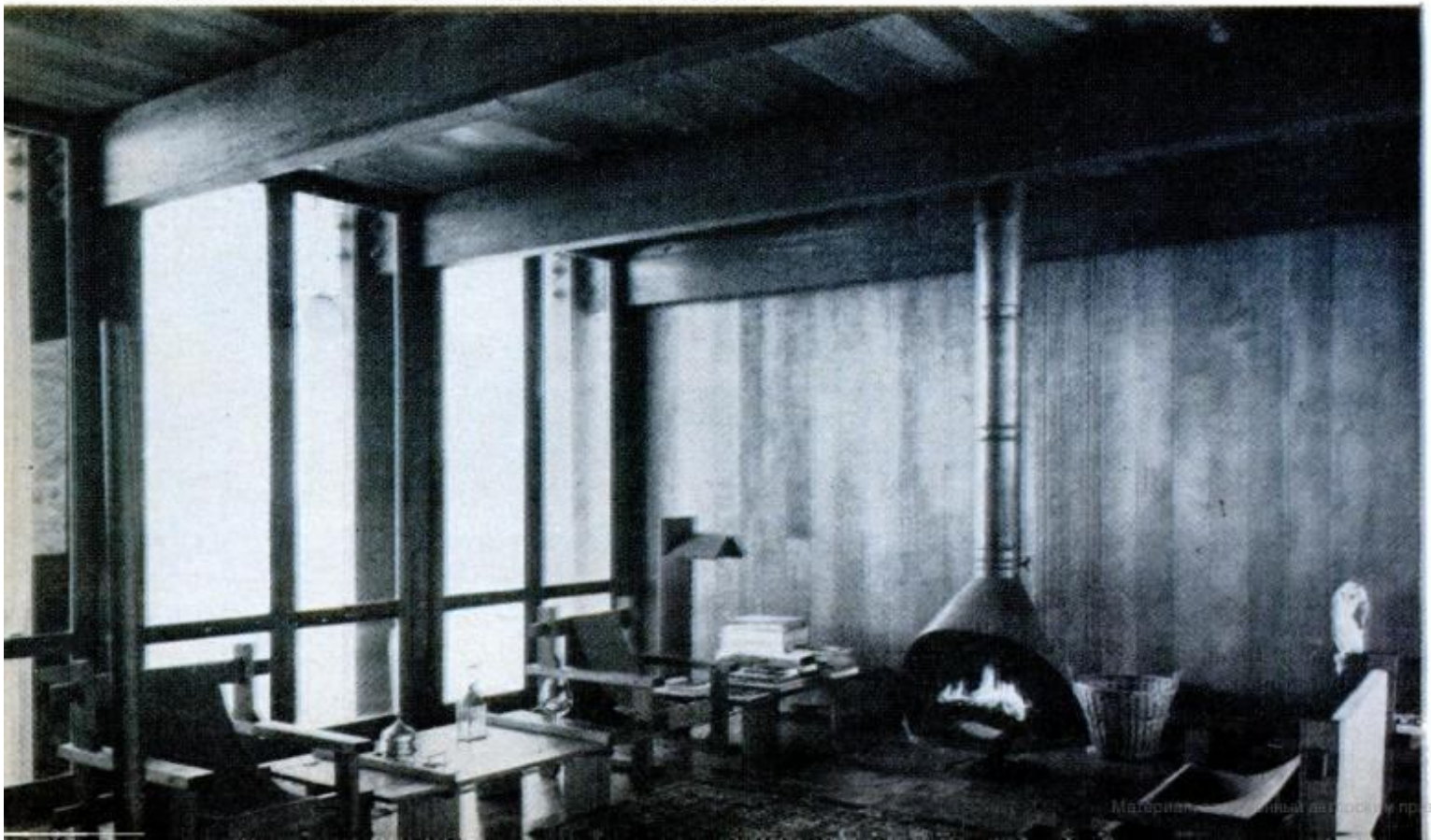
HOME SECTION

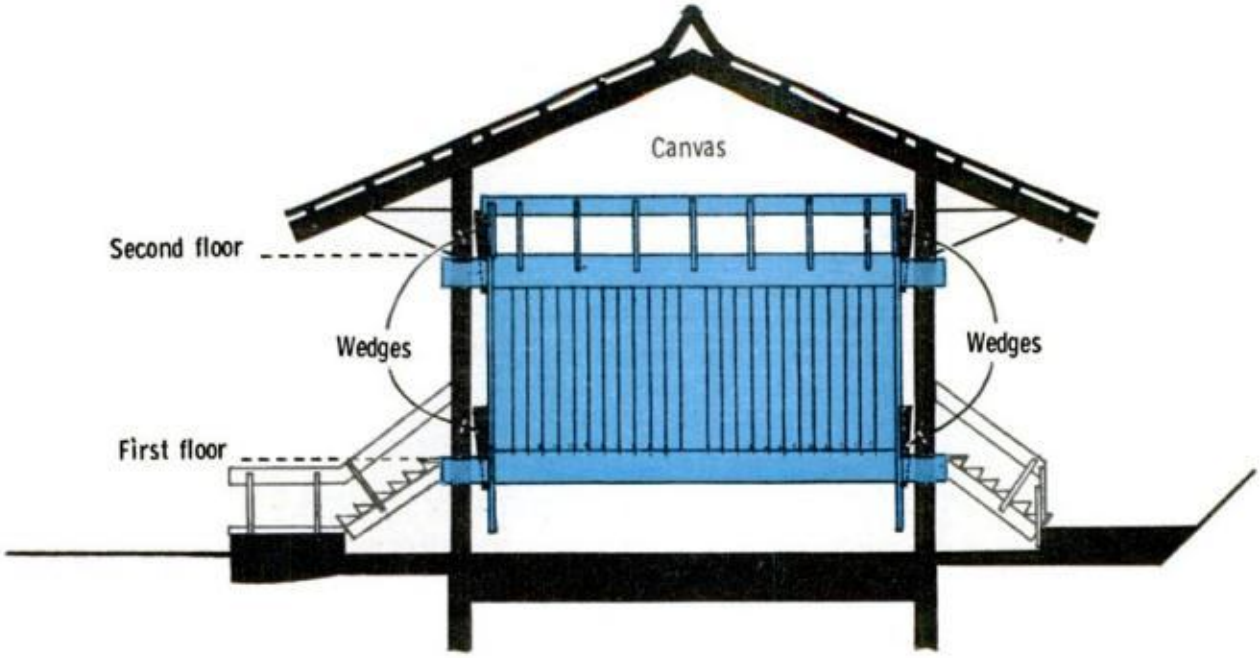
House Floats Inside Itself

Wooden shell containing the living area of this house near Beverly Hills, Calif., is slung inside an outer frame of massive posts and beams. For ultimate in indoor-outdoor living, occupants can open tall glass French doors on first floor and roll up canvas "tent" which encloses a bedroom and studio on the second floor. Only finish used on interior or exterior was a clear water-repellent sealer.

Simpson Timber photos

One big room—22 by 30 feet with 10-foot ceiling—comprises the first floor. Floor, walls and ceiling of this room, which is divided into areas for cooking, living, working and entertaining, are of Douglas fir 2 by 8s. Ceiling is actually underside of second-level flooring.



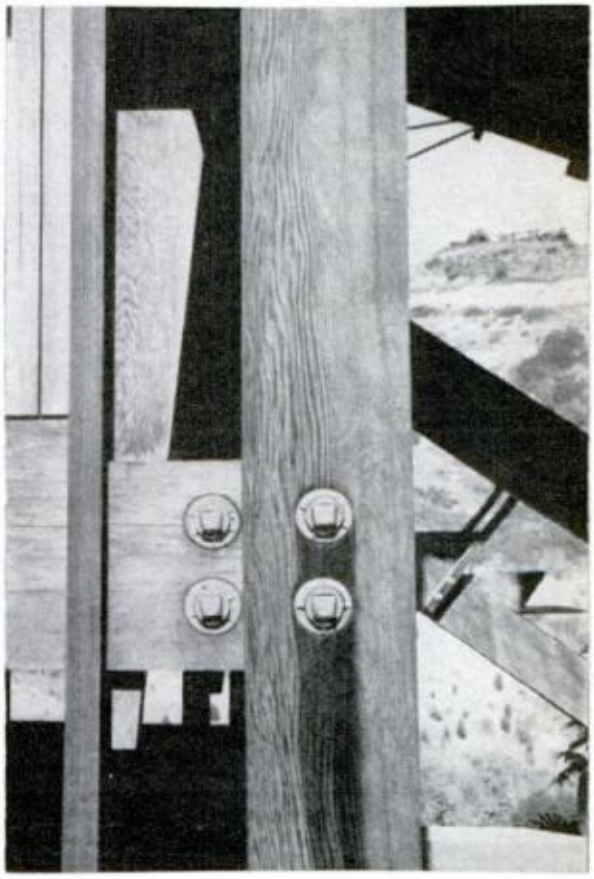


HOW DO YOU BUILD a wood house that will last indefinitely? According to architect Frederic P. Lyman, one way is to build two houses—one inside the other. That way, as demonstrated in this redwood structure, you can insure proper airing of every wood member, thus eliminating dry rot and termites.

As shown above, the house has two distinctly separate structural units. Essentially, the exterior unit is a frame of 4 by 16 rafters mortised and bolted into 10 by 14 posts. The roof is of corrugated asbestos-cement panels.

A shell containing the living area rests inside the exterior frame, and is held together without nails or glue by dado and mortise-and-tenon joints. It is also connected to the exterior posts by mortise-and-tenon joints, and secured in place by wedges (right).

The home's 1200 square feet of living space is divided into two stories. The first floor interior is finished entirely in natural wood. The second floor is actually an open framework in which a canvas "tent" forms the exterior walls and ceiling. An adjoining bathhouse (not shown) features a 300-gallon combination tub-shower unit.



Removable wedges which secure inner shell to outer frame allow wood structure plenty of "give" to compensate for expansion and contraction. Wedges also make house demountable, should owner want to move it.

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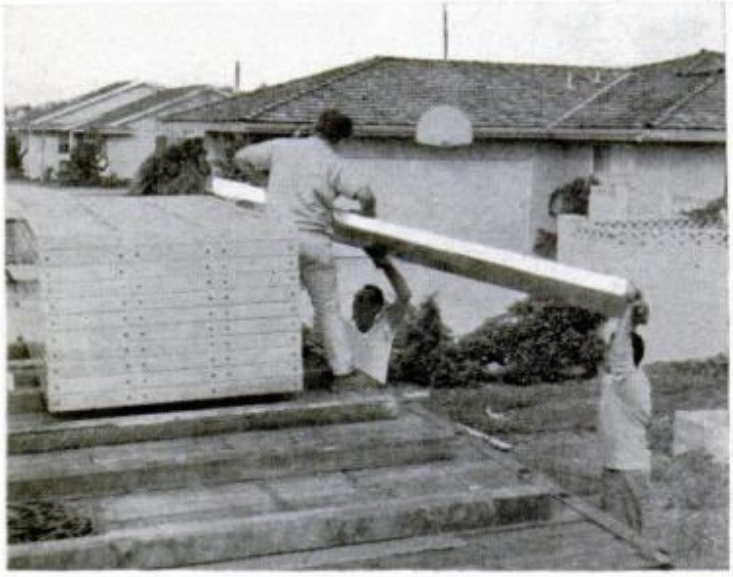
HOME SECTION

New Grab Bag

TO MANY, the word "prefabricated" once described a plain-looking, uninspired sort of house that was slapped together from pieces that more or less fit together into a serviceable structure. But things have changed, and the homes shown on the next few pages are evidence of it.

Now, some of the most interesting house designs come from the prefabricators—who prefer to be called home manufac-



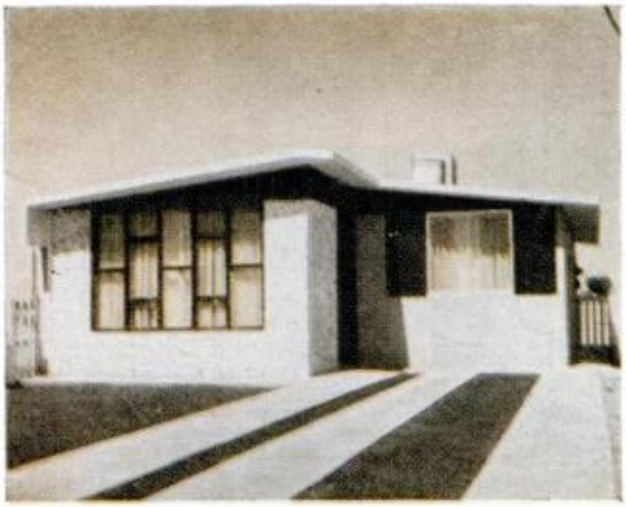
Four men took only four hours to erect this four-bedroom home made primarily of four by eight-foot galvanized-steel modular wall panels. The panels (top left) consist of galvanized sheet steel with gypsum-board interior lining and glass-fiber insulation. Exterior wall sections are connected by tight-fitting butt joints with no overlap (top right). Steel sections also act as a vertical load-carrying wall, impervious to rot and termites, with asbestos-textured finish. The completed home (above) sells in the $19,000 price range, exclusive of lot.

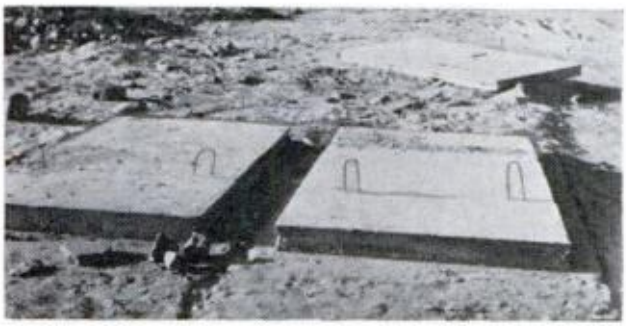
Материал, защищенный авторским правом

# of Prefabs

turers, by the way. And the watchword of the prefabbing industry seems to be "variety."

On these pages, you'll see what we mean. No matter what kind of house you want nowadays, whether it be stone-textured concrete or prefinished steel, contractor-built or do-it-yourself, permanent or relocatable, chances are a prefabricator can supply it for you.





Prefabricated concrete homes, prefabricated on the job, if you please, are the latest in second or vacation homes. The panels (above) are cast inside a four by eight-foot form after reinforcing steel and electrical conduit are installed. A typical panel is five inches thick, consisting of two inches of lightweight concrete, about an inch of insulating vermiculite core and a final layer of concrete. Sufficient concrete seeps into the vermiculite to bond the two layers of concrete together. Each slab is keyed on all four edges to make a mechanical fit with the adjoining slab. The panels are lifted into place by crane after the floor slab has been poured and cured. The roof, four inches thick, is poured as one piece, reinforced with steel bars and insulated with vermiculite. Produced in Mexico, a typical 530-square-foot home (top, left) could be sold in the United States for less than $5000. A variety of texturing (above) is possible, using stone or pebble veneers or ornamental wood paneling. The system is applicable to any sort of floor plan and for variously sized homes. The first U.S. use may be in tracts of small homes for our senior citizens.

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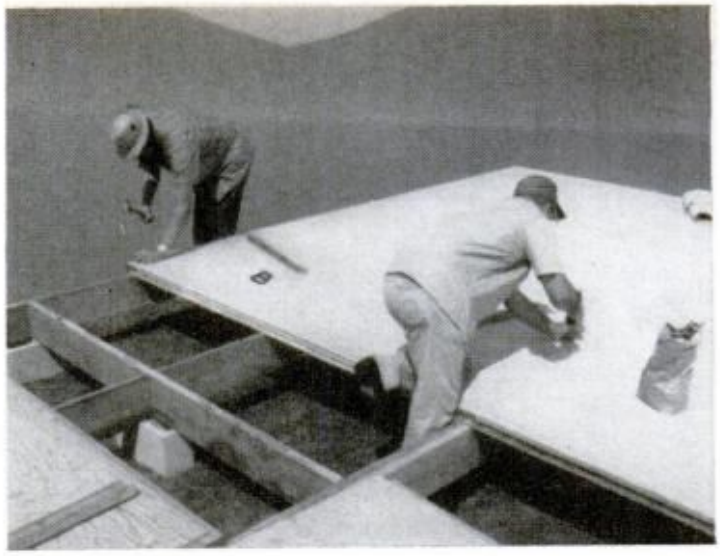

Perhaps the most attractive new prefab, pricewise, is this 448-square-foot plywood shell, at $1988 for two bedrooms, bath and combination living-dining-cooking area. Plumbing, electric and porch "packages" are extra. It can be erected in one day by two or three men. The panels, which are load-bearing, are faced with red-cedar plywood with an insulating core of polystyrene foam and interior facing of Douglas fir. The roof panels are faced on the top with cement-asbestos board. The roof is made watertight by a bead of sealant between panels and a special plastic tape over each joint. The four by eight-foot floor panels (top) are nailed to the support beams with common 16-penny nails. Any standard foundation material, such as cement blocks, can be used. The wall panels are then set in place in order, and toenailed to the floor (center). The finished home (bottom), while not the most luxurious accommodation, is a substantial answer to the outdoorsman's search for a second or vacation home.

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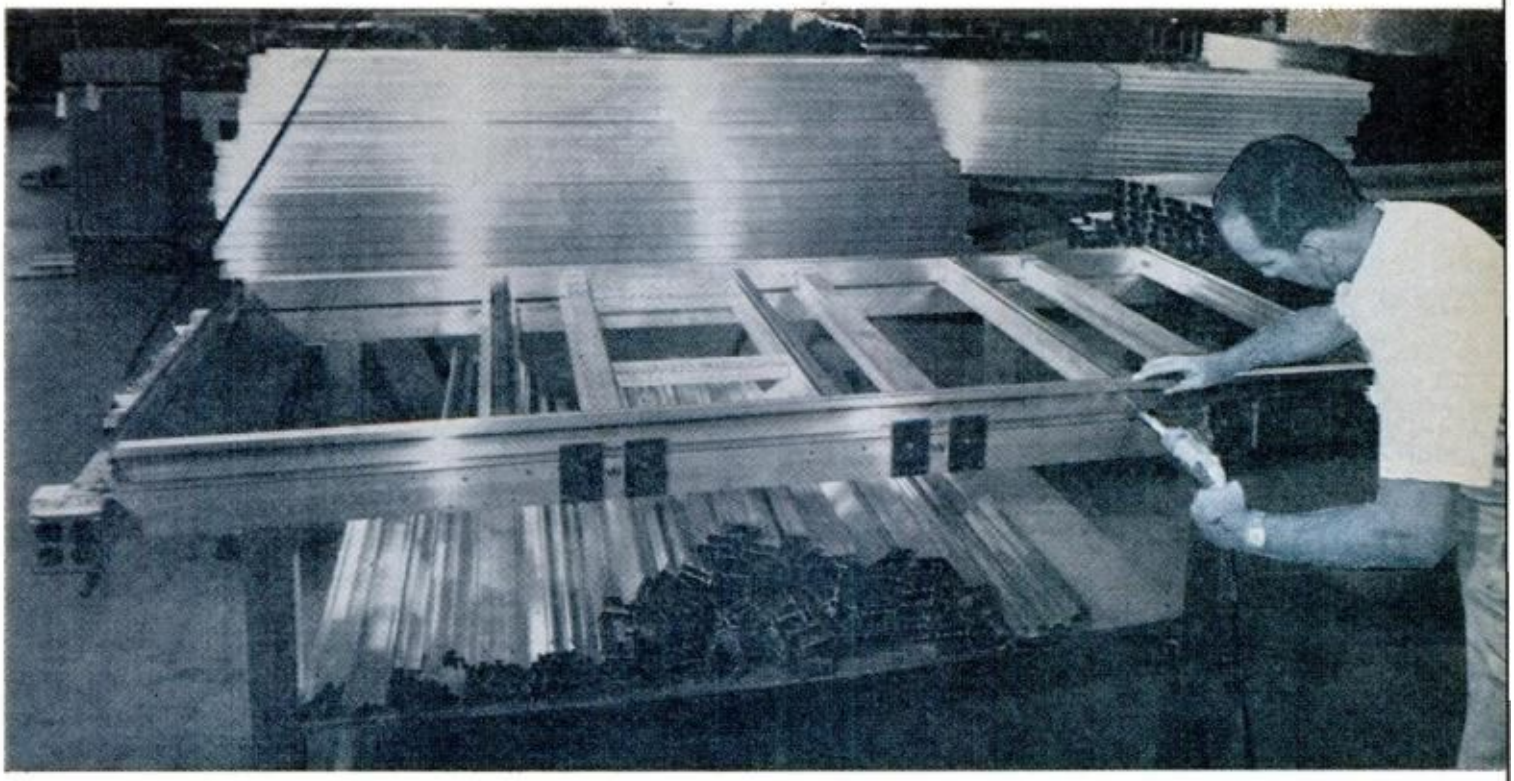

Aluminum-frame panel homes are another answer to the prefab leisure house. The frames (top) are finished with three-inch-thick glass-fiber insulation sandwiched between a hardboard exterior panel and an interior wallboard panel. Electrical conduit, switch boxes and outlets are factory installed, and a small home can be erected by three men in three days. Exterior panels weigh 111 pounds, and interior panels (left) less than 100 pounds. The completed home (above) costs about $4200 for 530 square feet. The roof trusses are fabricated of aluminum extrusions bolted together and stiffened with plywood. Any ordinary commercial-type roofing, hot-mopped with asphalt and coated with gravel, will finish it off.

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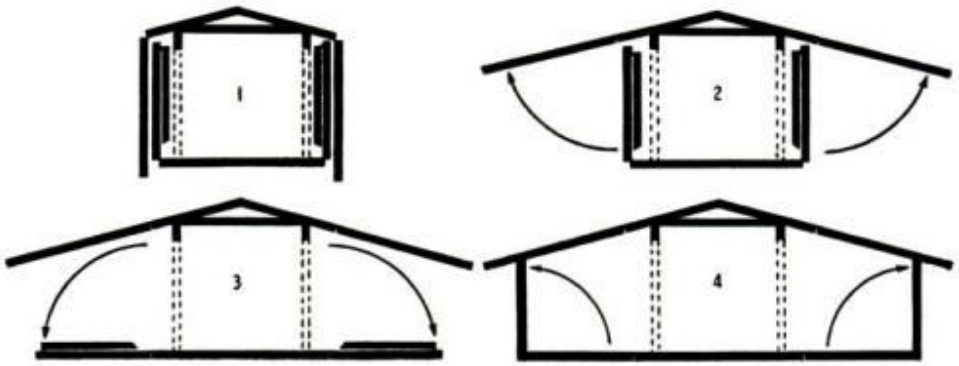
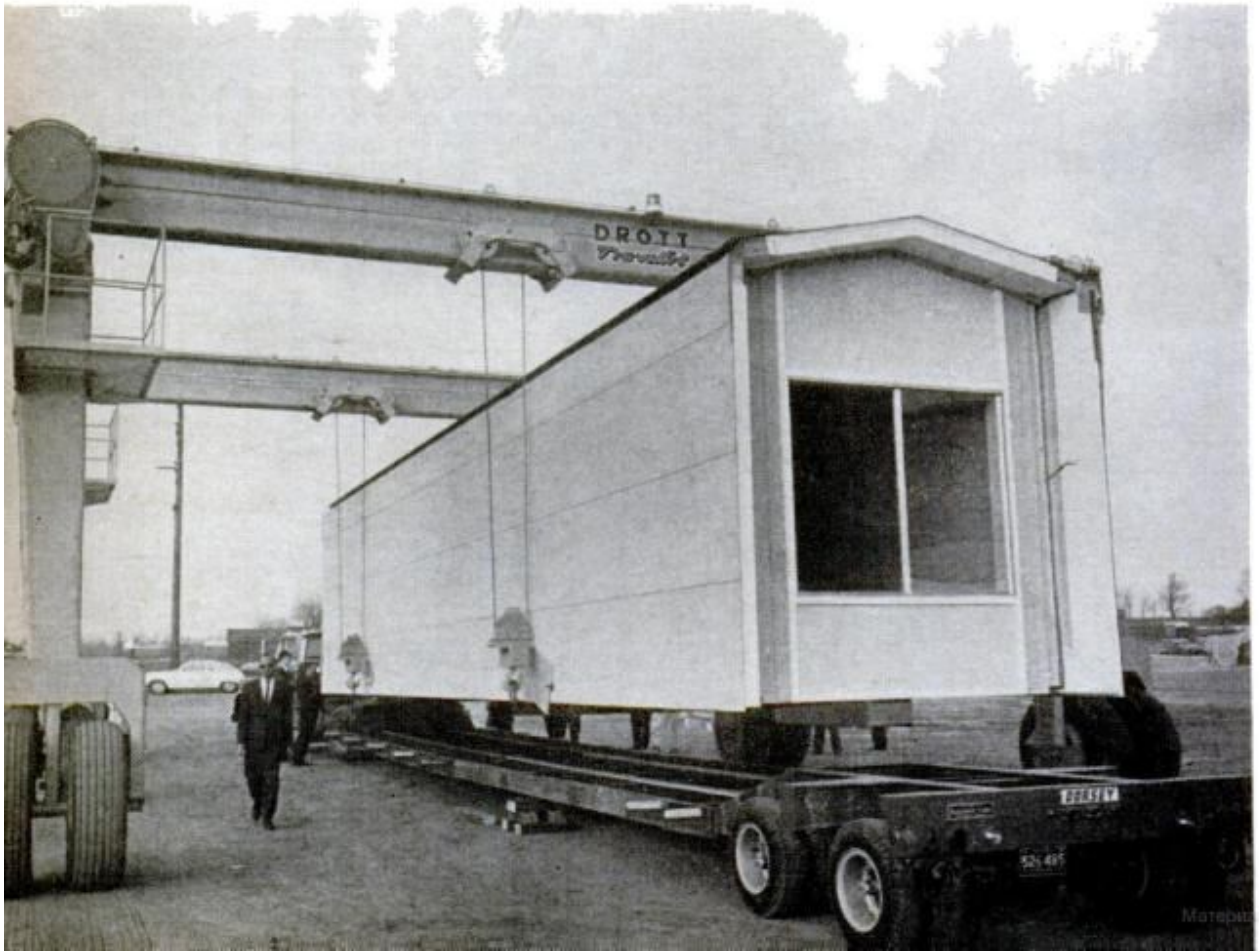


Take your house and go: Built originally for Air Force personnel who move from base to base frequently and can't afford the problems of selling and buying homes at each station, these folding homes can be packed up and towed to the next base. And they may soon hit the civilian market as temporary homes for engineers and others with transient jobs. The basic house (left) consists of about 1150 square feet, divided into a living-dining area, three bedrooms and one-and-a-half baths. The factory ships each house folded (below). Once on a foundation, it's unfolded (above) via giant-size piano hinges, and prepared for occupancy—usually within five days. Generally, standard building materials are used throughout these homes.



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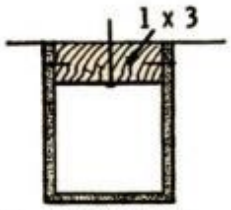
New Materials for Quick Remodeling

By Arthur J. Maher

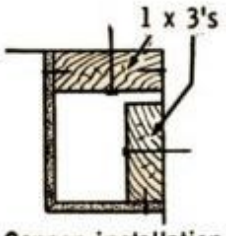
SPEED. That's the big word in remodeling today, and it's reflected by the hot new materials pouring out of the building materials industry.

The lightweight folding beams shown below, for example look about as much like real walnut as real walnut does. But putting them up is a breeze compared to the real thing. And what heating system installs easier than the one on page 134? It rolls on like wallpaper.

But with today's materials the time saving doesn't end when the job is finished. Years later, products like the wall covering on page 136, which peels off in a jiffy, even help you start the next remodeling job faster.



Normal installation



Corner installation

Poor man's walnut beam costs only about 50 cents a foot. Its realistic vinyl surface is laminated to hardboard. To install, you nail a 1 by 3 to the ceiling, fold the beam around the 1 by 3 (drawing) and nail. At corner, you merely cut off one side of the beam with a knife and put an extra 1 by 3 on the wall. Vinylfold is made by National Gypsum Co.

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Radiant heating system rolls on your ceiling like wallpaper. Sun-Glo is made of two layers of thin vinyl with a nylon net between (left). Thin wires in the nylon produce heat. After running a wire from a sheet through the ceiling, material is applied with mastic and rolled smooth. Operating temperature—about 100° F.—is close to human body temperature. Available in decorated sheets measuring 2 by 4 ft. to 2 by 14 ft. and unfinished sheets ranging from 26 by 50 in. to 3 by 12 ft. Costs around 50 to 75 cents a sq. ft. installed, and uses 240-v. power. From Goodyear.

Light up a whole ceiling, or just accent it with spots of light. Nu-Grid light panels are made for standard T-bar suspended grid ceilings. Installed under fluorescent fixtures, they give pleasant, glare free illumination. Offered in four types—plain opal, clear and opal prismatic, and egg crate (resembles honeycomb). All are of polystyrene plastic. Manufactured by Wood Conversion Co. in 2 by 2 and 4 by 4-ft. sizes. Prices start at about $2.25 per panel.

Warm up that chilly spot in your living room with new inch-thick electrical heating panels from 3M. Available in models for hanging right on your wall or ceiling, or for flush mounting in suspended ceilings. Operate on 120-v. or 240-v. a.c. or d.c. current, at safe temperatures of 184° and 165° F. Built-in reflectors and insulation throw heat into room. Heating surfaces can be painted. Cost $34.95 and up in 500-w. and 750-w. capacities. Sizes run 2 by 4 and 3 by 4 ft.

Don't cut your headroom: Grid ceiling system from Insulite is ideal for basements or other areas where a regular suspended ceiling would reduce the headroom too much. It uses Z-strips which you attach right to the joists with nail-on clips, and standard T-bars that fit into the Z-strips at right angles. From there on it's like other grid systems. Headroom Ceiling runs about 25 cents a sq. ft. and up.

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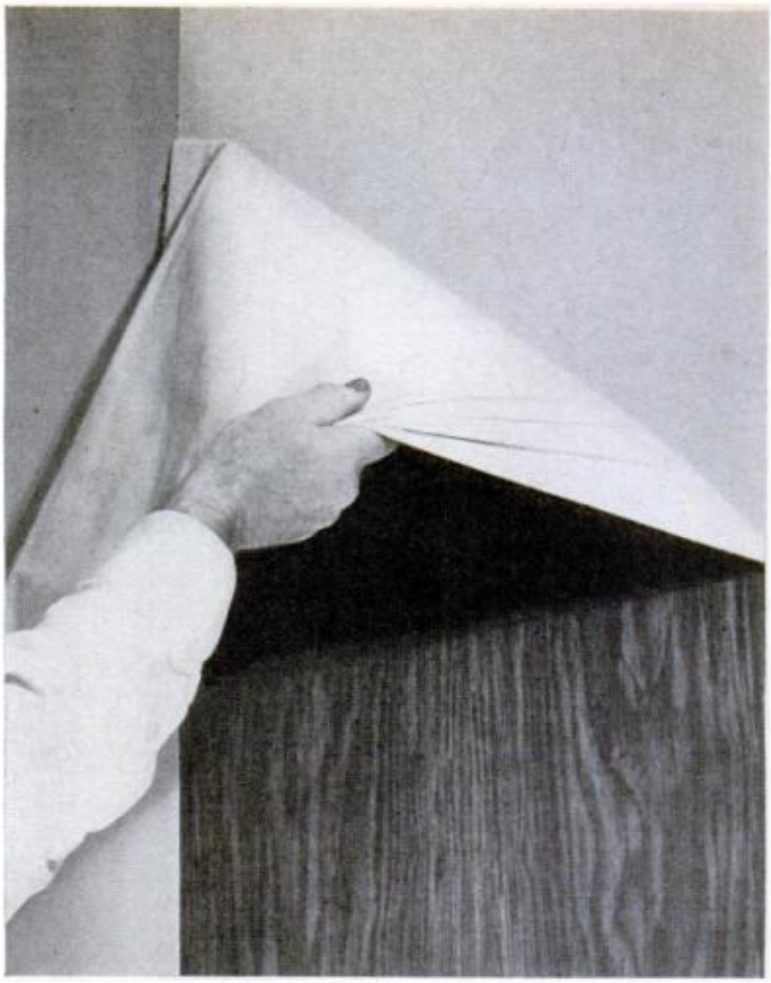

Easy on, easy off: A new line of self-adhesive vinyl wall coverings use a pre-sized paste that eliminates the need to size the wall and is said to dry free of visible bubbles. In addition, when you want to redecorate, all you do to remove the vinyl surface is loosen a corner and rip it off. A paper backing that stays on the wall is easily scraped off when wet. This material is especially suited to areas such as bathrooms and kitchens because it resists moisture, stains, crayons, grease and the like. Made by Canadian Wallpaper Manufacturers and priced at $3.95 a single roll.

Sound-condition walls, ceilings and floors with this polystyrene foam. It's light weight makes for easy handling and its softness makes it easy to cut with knife or saw. Apply it to ceiling joists or wall studs with nails or staples, then put on the gypsumboard or other finishing material. On floors, it can serve as an underlayment. Made by Zonolite in 8-ft. sheets or 100-ft. rolls. It's 16 in. wide, $\frac{3}{8}$ in. thick, has a kraft paper covering and sells for about 5 to 6 cents a sq. ft.

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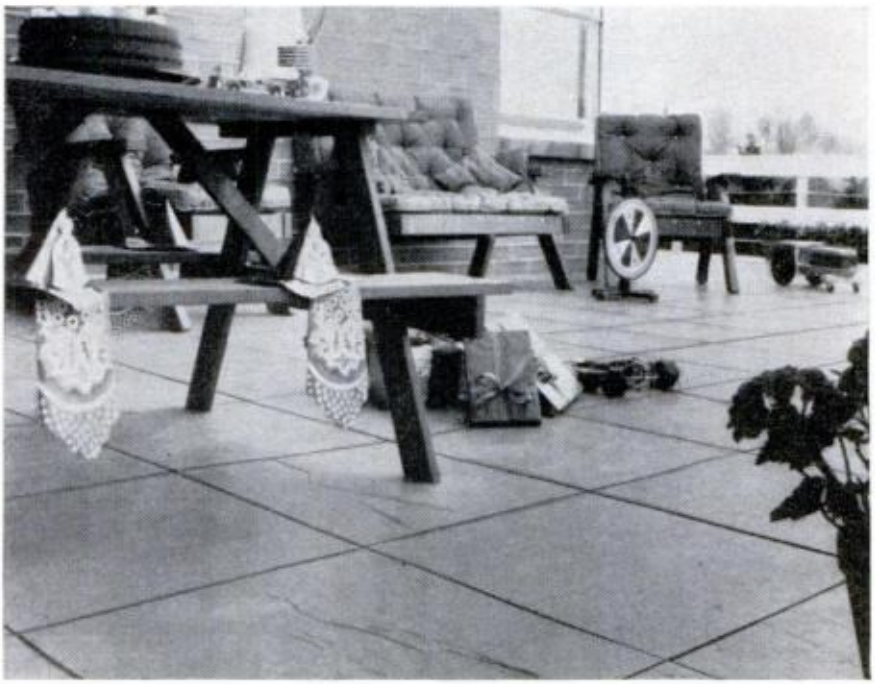

Durable floor system was specifically designed for outdoor sunporches and decks. Consists of a waterproof elastic membrane which goes over the decking, and 18-in. square resilient tiles that resemble slate. The manufacturer says the tile, the first intended for outdoor use, should last the life of the house. No waxing needed. Installed price of an Armstrong Travelon deck is about $2.50 a sq. ft.

Wood-metal wall paneling: Just when we thought the plywood people had run out of unusual paneling ideas, Georgia-Pacific came up with an eye-catcher. It's a ¼-in., 4 by 8-ft. material with ½-in. copper inlay strips. The wood itself has a light brown pecky surface that imparts a tasteful antique effect. Price, $29.95 a sheet.

Siding has tough skin: Super-Gard aluminum siding is coated with polyvinyl chloride plastic which, according to the manufacturer, resists abrasion much better than other aluminum-siding finishes. In addition, it comes with unusual striated and wood-grain textures in green, sandalwood and white. Costs $80 to $95 per square, installed.

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HOME SECTION

New for Your Home

Vacuum sports adjustable extension wand that telescopes from 19 inches to three feet for floor to ceiling cleaning without changing accessories. Shoulder strap lets hands be free. $24.95: Troy Industries, 135 Marbledale, Tuckahoe, N.Y.

Fold-away workbench becomes an instant workshop with a 24 by 42-inch work area supported on steel legs. Project includes tool box, light vise and plug for power tools. Plans are $1.95 from Philco Industries, 6343 Prospect, Dallas, Tex.

Tabletops of fused wood core and plastic shrug off active wear but look like fine furniture. To transform a top into a table, attach legs with a small drill and screwdriver. Wood-grained Silvaplex tops in 36 or 42-inch diameters start at $15; legs are separate. Available from lumber dealers selling Weyerhaeuser wood products.

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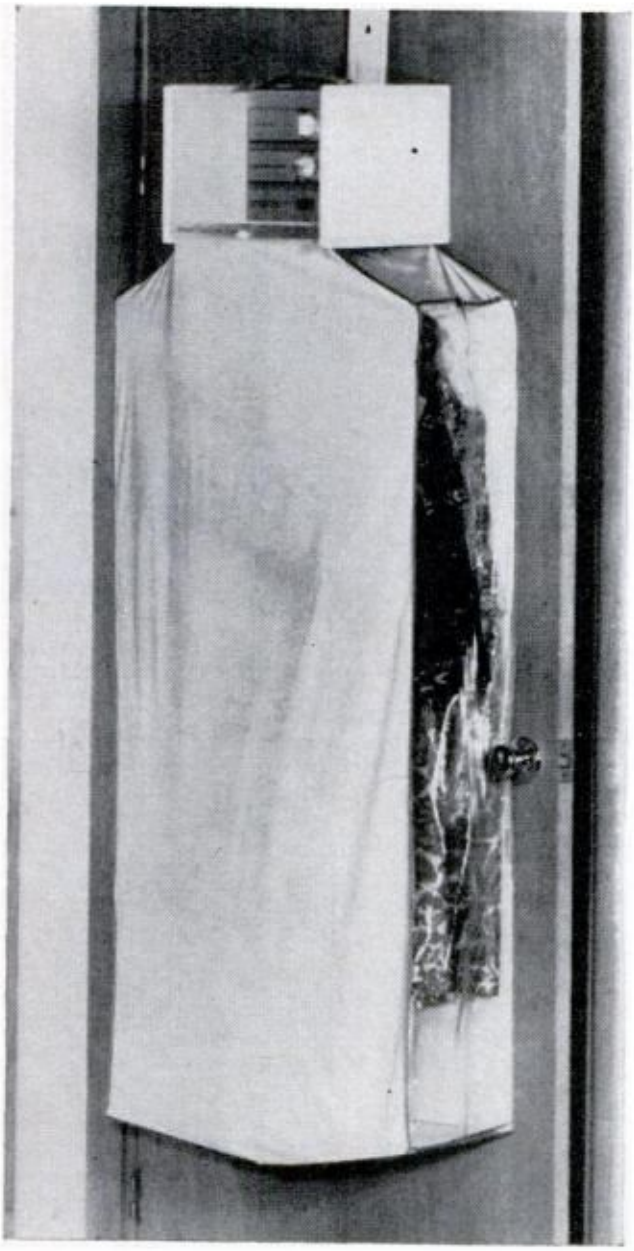
Tool stool is a 14-inch-square step stool which totes cleaning supplies and hardware in its open floor. Drawer houses 18 tools including hammer, saw, wrenches and pliers. Cost: $13.50 complete. By Wainwright, 2714 Chelsea, Charlotte, N.C.



Portable clothes dryer travels well, mounts on walls or doors. Plug 12-foot cord into outlet; unit runs up to an hour, sets from 35 to 130°F, shuts off automatically. $39.95. By Consumer Products Div. of Arvin, Columbus, Ind.

Collapsible chairs designed in Italy weigh under ten pounds. Elasticized seats, rust-proof frames and portability suit campers or patio sitters. In three sizes, chairs start at $22.95. Miguel Figueroa, 626 McArthur, Redwood City, Calif.

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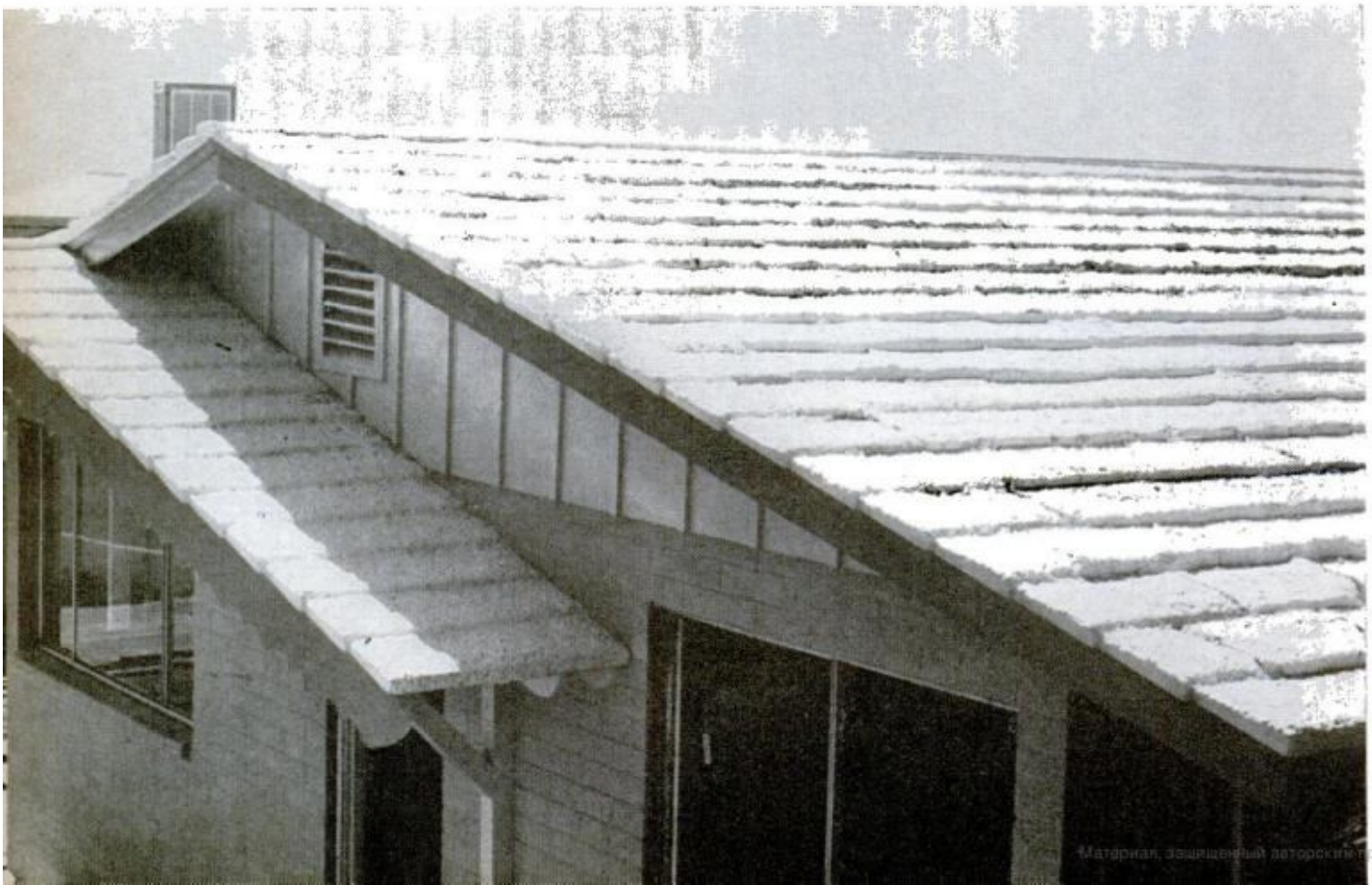
HOME SECTION

Leaner Look in

Workman molds concrete roof by pumping mixture of cement and vermiculite into forms, after sheathing has been covered with a waterproof membrane. When concrete sets, a coat of paint finishes the job. Attractive, long-lasting roof protects house from fire while providing good insulation. It's also wind-resistant, needs little or no maintenance.



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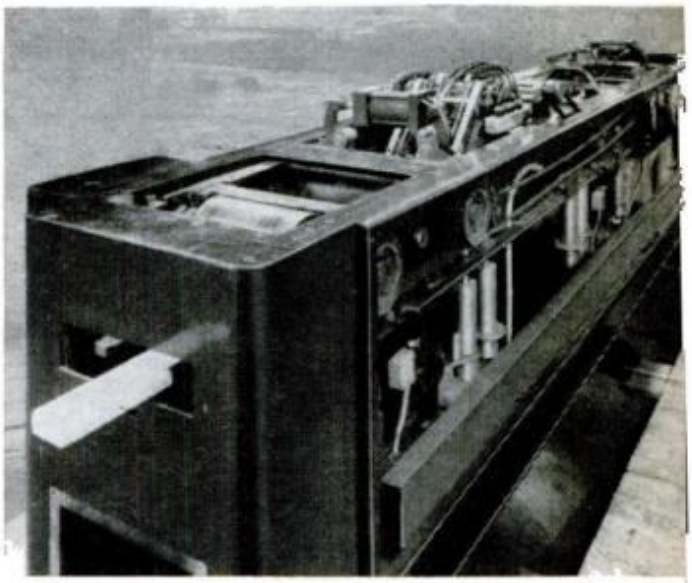
Home Building

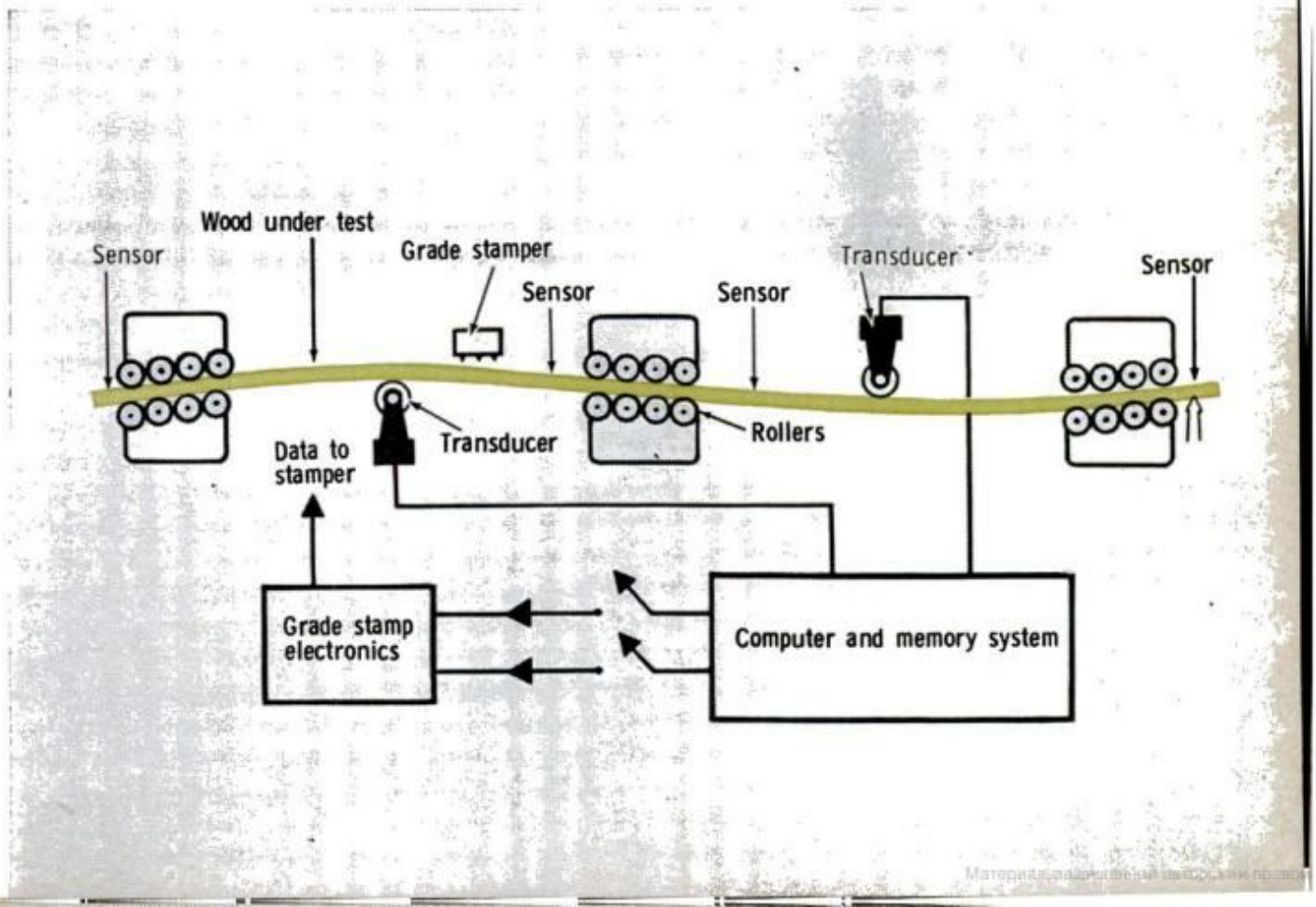
YOU SAY you like the house you live in? It's warm, comfortable, pleasing to the eye? Well, we're glad you like it because chances are you paid too much for it.

No, we don't mean you were gypped. It's just that the present state of home building technology requires builders to put into every house a lot of excess labor and materials—extra fat, so to speak, that accomplishes little more than adding to the homeowner's burdens.

But take heart. When the bottom dropped out of the housing market in the late 1950s, it jolted the industry into action. It was obvious that to maintain a healthy market, the upward spiral of building costs had to be stopped. Result: trade groups, universities, manufacturers and even individual builders took dead aim on the problem. Their findings promise a brighter day ahead.



Eliminating guesswork from grading of lumber, complex machines (above) flex boards first one way then another (below). Sensors and transducers measure interaction of wood's grain, moisture content, knots, other factors, and grade is stamped on the board.



One way to streamline house construction is to make a single material do several jobs. Zonolite has done that with its Bermuda Roof system, in which concrete is molded into a roof covering that resembles wood shakes, but provides fire protection and insulation as well. Cost runs about $42 a square—higher than shakes or asphalt shingles. However, the manufacturer says the roof should last a lifetime, thus canceling the higher cost.

Because wood is America's basic housing material, researchers are giving it a particularly careful eye. Perhaps the most dramatic result so far is a method for machine stress-rating each stud, rafter and joist going into a house to find its exact strength. In previous rating methods, an expert would examine each piece for knots, grain pattern, splits and the like. Then, knowing the wood's specie, he would rate the pieces according to his estimate of their grade. The obvious roughness of such guestimating forced designers to use more wood than was actually needed in order to be on the safe side—to space rafters 16 inches apart when 24 inches might have been adequate, or use, say, 2 by 10 floor joists when 2 by 6s might have sufficed.

With stress rating, each piece of lumber is flexed inside a huge computerlike machine that determines its strength based on the reactions of its fibers to the flexing. Such precise grading lowers the required safety margin, often permitting savings of 25 percent in materials.

Another wood cost-saver is an experimental floor and foundation system developed by the National Forest Products Association and Washington State University. Called, rather imposingly, the low-profile plenum system, it can run $200 to $300 cheaper per house than conventional crawl space construction. Among other advantages, it cuts the amount of digging required for the foundation and provides a plenum space under the floor through which heated air from the furnace can be circulated into the house via registers or slots around the edges of the floor. Ductwork is eliminated, the floor is pleasantly warm, and the shallow plenum space insures a light load on forced-air circulators. Also, the system uses precast concrete grade beams and pads that require no footings, thus eliminating costly bad-weather delays in foundation work.

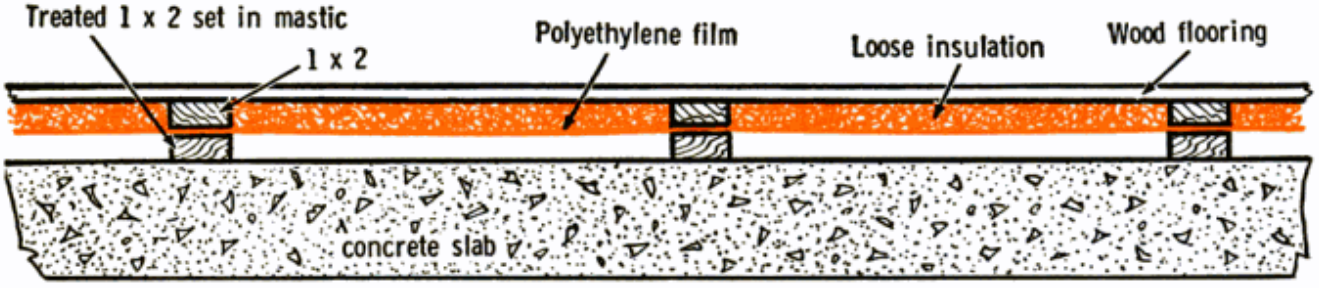
A similar foundation system tested by the University of Illinois' Small Homes Council and Koppers Co. promised savings of $140 compared to conventional crawl spaces and $280 compared to slabs.

While the schools and research teams experimented, builder Andy Place of South Bend, Ind., perfected his own foundation system that delivers a trouble-free no-squeak wood floor and a crawl space foundation while saving 46 man-hours' labor compared to conventional slabs covered with tile flooring. Here's what he did:

- By using precast, prestressed concrete foundation walls, he cut bad-weather delays. The walls—actually huge beams—rest on concrete pads and are fastened together at corners by welding their projecting reinforcement rods.
- Replaced piers with steel jacks.
- Reduced the number of joists by using steel joists instead of wood.
- Nailed a one-step combined subfloor and finish floor to the steel joists.

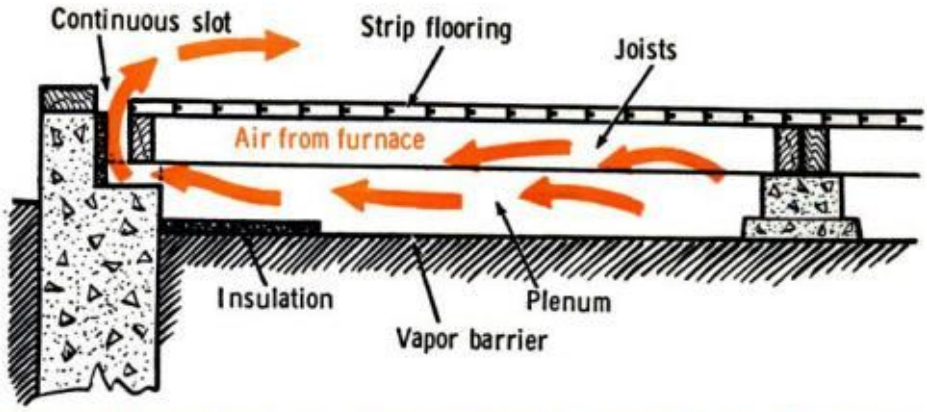
Another builder, Bob Schmitt of Berea, Ohio, is applying subflooring, underlayment, paneling, stair treads and risers, and various accessories with adhesives. Schmitt reports no substantial cost savings, but

(Please turn to page 226)



No subflooring needed in this insulated wood floor designed for homes built on concrete slabs. Lower 1 by 2s, treated to resist decay and termites, are fastened to concrete by nails and adhesive. Polyethylene film serves as a vapor barrier and supports a layer of loose insulation such as vermiculite which makes floor warm underfoot. Strip finish flooring is nailed directly to upper 1 by 2s.

Low-slung foundation and floor system creates a 12-inch space (plenum) under floor. By circulating heated air through space, builder eliminates ducts. Other economies are elimination of subfloor, use of lighter framing than conventional floor systems. Foundation hugs the ground, permitting low-silhouette styling like that in concrete-slab homes.



Builder-developed foundation system replaces wood joists with 14-gauge 2 by 7-inch galvanized steel beams spaced 4 feet apart. Beams rest on steel jacks (left, above). Prefinished sub and finish floor, laminated together, are applied in single operation with hardened nails (right). System also eliminates the heavy wood sill usually anchored to the foundation, because wall framing can start right on the floor.

Sticky floor system: Another builder reports that applying subfloor and underlayment with adhesives gives no-squeak floor. Workmen apply rubbery adhesive to joist edges (left photo), varying thickness of beads to compensate for high and low spots along joists. Subfloor is then put down, held with few nails. Troweled-on adhesive (right) holds underlayment in place. Same builder uses similar techniques on stair treads and risers, paneling, mirrors.

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HOME SECTION

Great Hobby

Instant Office in a Closet

IF A SUITABLE PLACE to work is keeping you from enjoying the great pleasure of a hobby in your already cramped home or apartment, take heart!—there may be space going to waste right under your nose where you can "set up shop" as a coin or stamp collector, rock hound, budding author, home-movie buff or fishing bug.

The four great and exciting hobby corners you find here and on the next six pages are from the sketchboard of *PM*'s new design consultant, Franklyn Jacoby, noted New York industrial designer, and were built and photographed through the co-operation of Simpson Timber Co.,

(Text continues on page 148)

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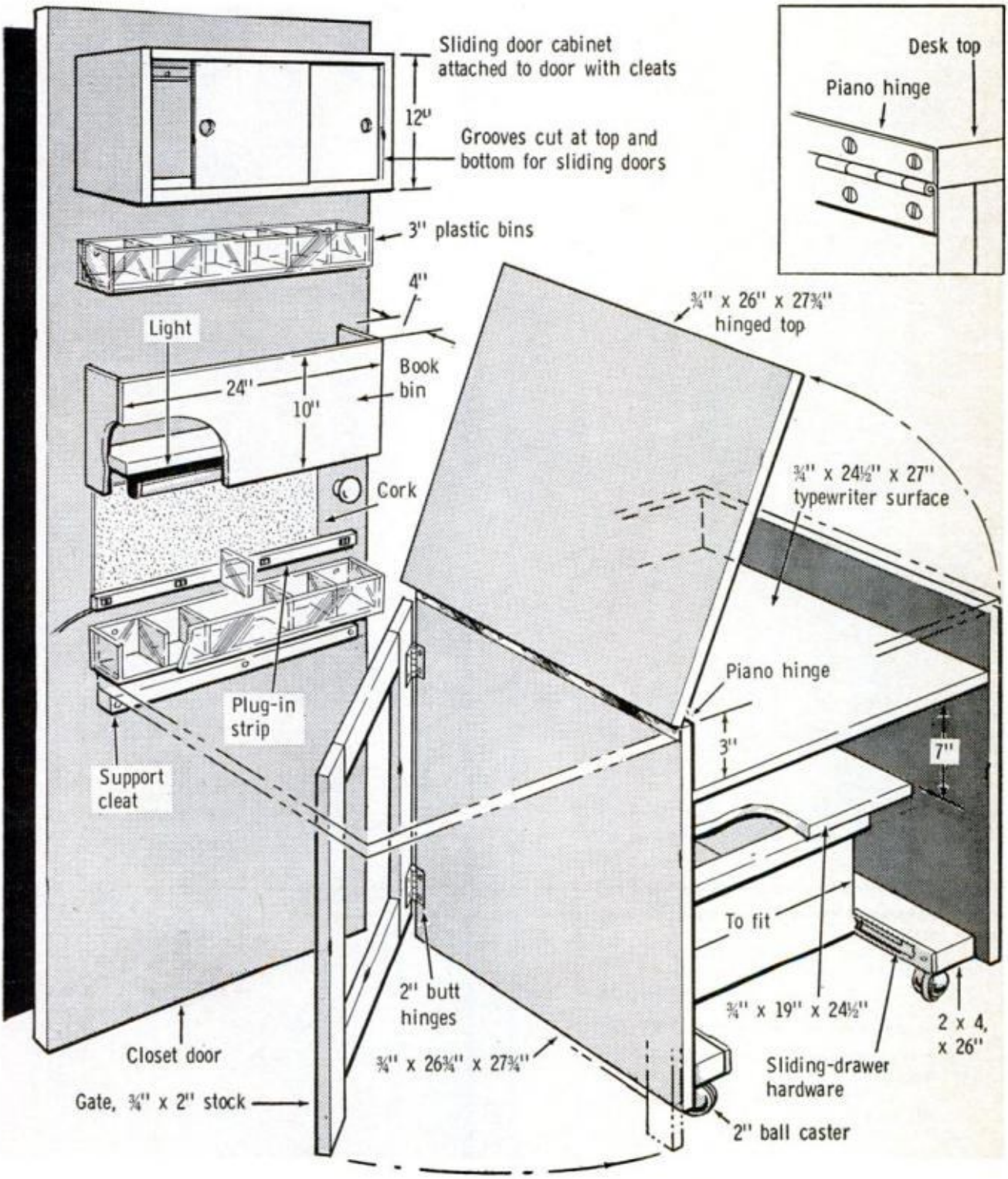
Corners in "Waste" Space



Two-level shelves of the proper height for writing and typing are incorporated in the hitch-on cabinet of the instant office. The bin file-drawer pulls out free of the floor on standard drawer-guide hardware, and new ball-type casters make it roll easily when the machine is stored and the file is full. Most of the cabinet is made from Simpson medium-density overlaid plywood. Plastic fronts make it easy to see into the "paper clip" bins attached to the door.

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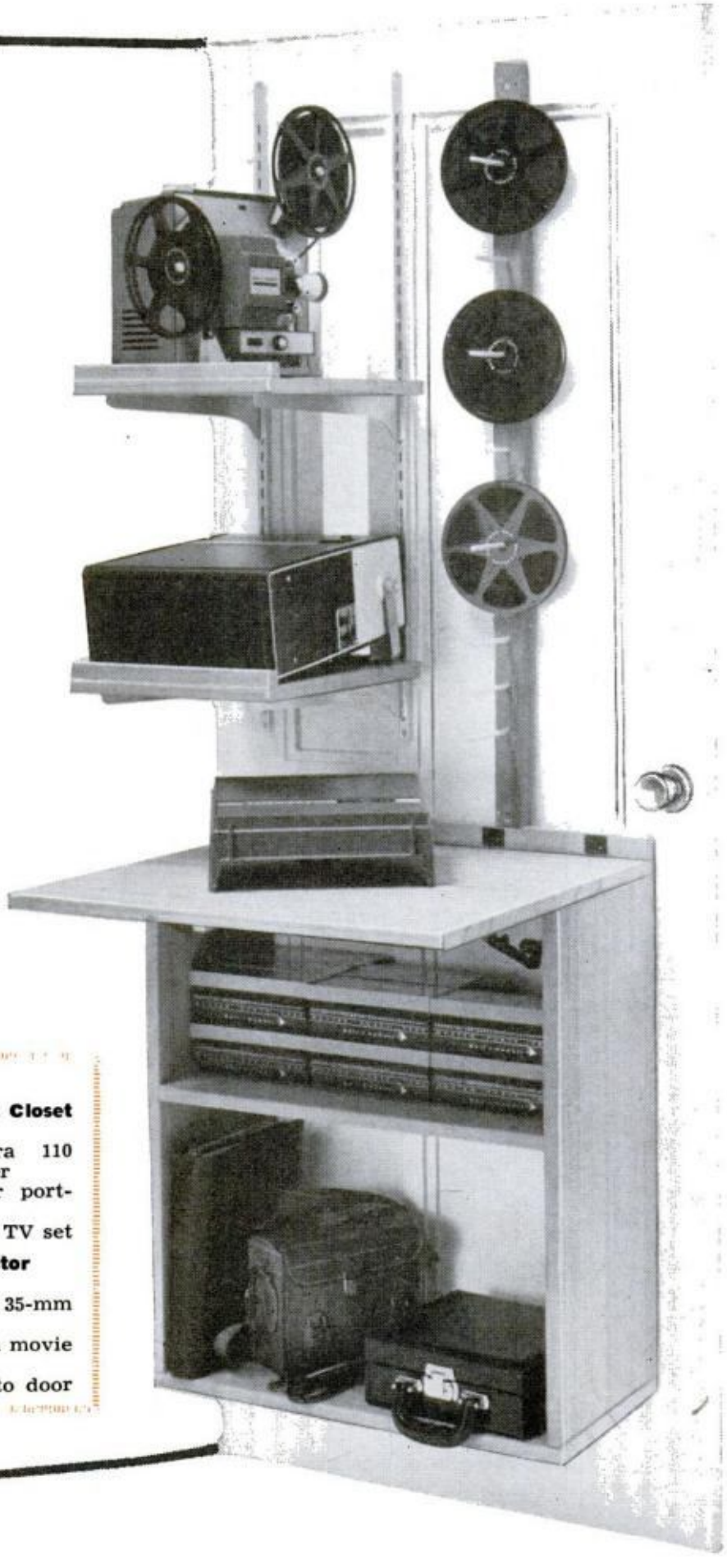
Closet Projection Room



THANKS

Equipment shown in Instant Closet Office:

Smith-Corona SCM Electra 110 portable electric typewriter
Channel Master 6-transistor portable tape recorder
Channel Master 12" portable TV set

Equipment shown in Projector Room:

Bell and Howell Slide Master 35-mm slide projector
Bell and Howell Super 8-mm movie projector
Simpson Symphonic Concerto door

CUT, FOLD, TAPE

HOBBY CORNERS

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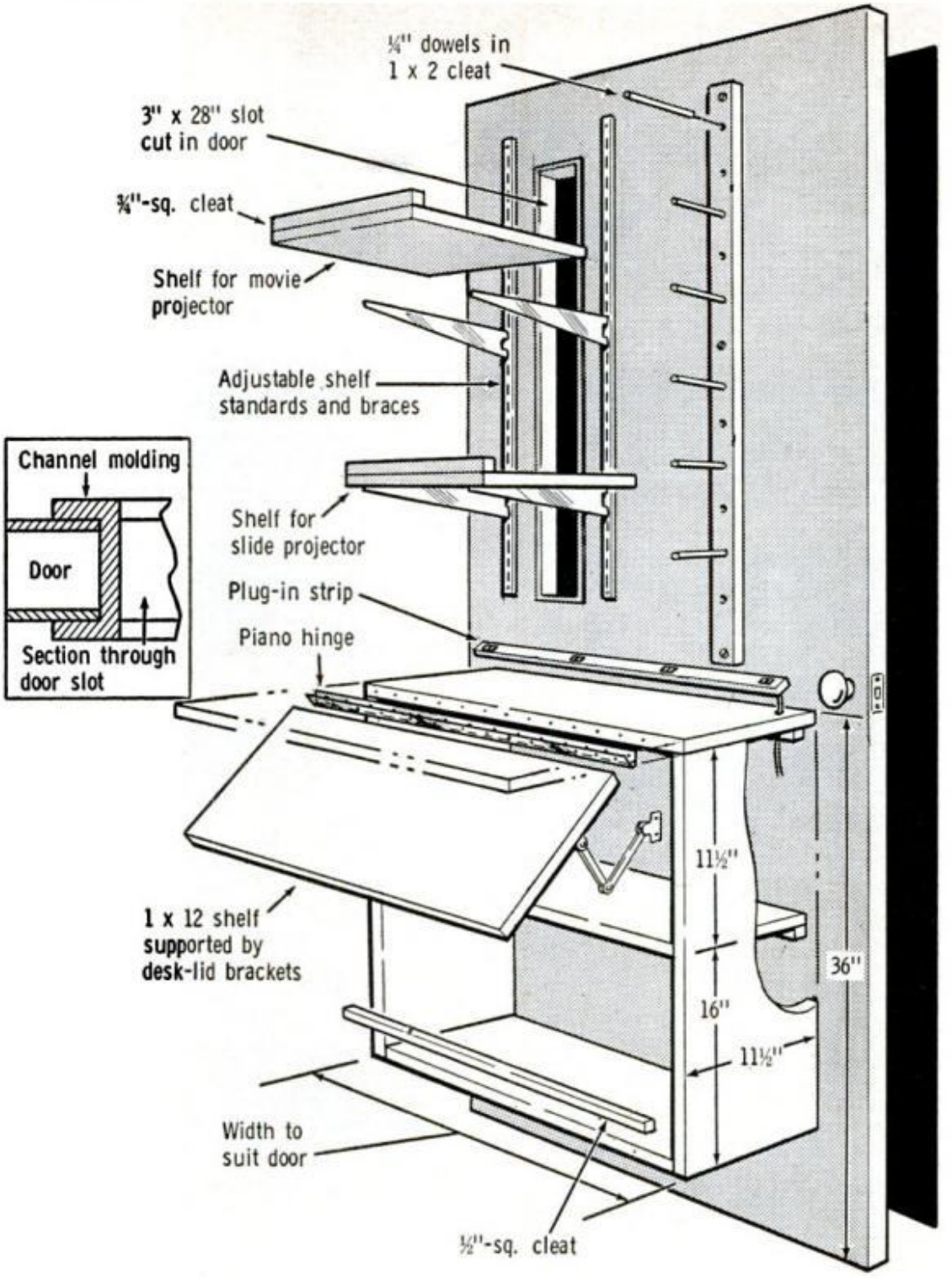

Where the door swings outward, a closet can be turned into an instant projection room without taking any floor space—the whole works is simply attached to the back of the door. The drop leaf of the cabinet provides extra counter space when pulled up, and there's shelf space aplenty for an editor-splicer, slide files, reel cans, camera bags and what-not. Shelf-bracket standards let you adjust the projector shelves, and dowel pegs keep reels handy for a full-length movie or a program of shorts. A standard plug-in strip connected to a receptacle inside the closet provides fingertip "juice" for the projectors. In the case of a hollow-core door, the lens port is trimmed with a mitered channel molding to line the opening. Sheet-metal screws will hold best in attaching the shelf standards to the thin plywood covering. In the case of a Simpson Symphonic (Concerto) solid-core door, you'll have no problem in attaching the cabinet with cleats.

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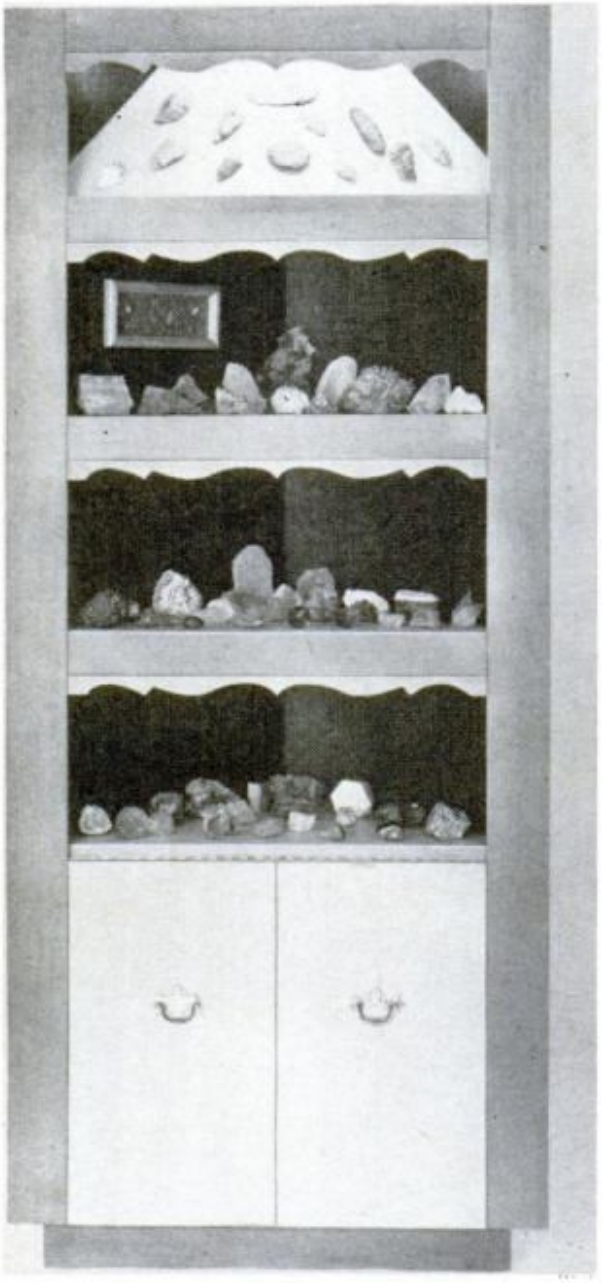
Collectors' Corner



(Continued from page 144)

makers of Certified Kiln-Dried All Heart California Redwood, Paint Guard Medium-Density Overlaid Plywood and Symphonic doors.

Of the four hobby corners presented here, the instant office in a closet is a nifty from the word open. Like the projection room setup, it makes use of waste space on the back of a closet door, so that when you're in the mood to dash off a bit of literary work or show your latest vacation slides to your friends, you're set up for business with everything at hand by doing little more than swinging open a door. The rolling desk with its flip-over top and built-in file drawer may be parked inside or outside the closet. Parked outside, as shown in color, it becomes doubly useful as a table for a portable TV. When set up, the desk top is supported by a swing-out gate and a cleat attached to the closet door. Bins and racks for office supplies, plus a built-in light, make this instant office the handiest thing ever where one is pinched for space.

A port in the door of the projection-room "corner" lets you show slides and

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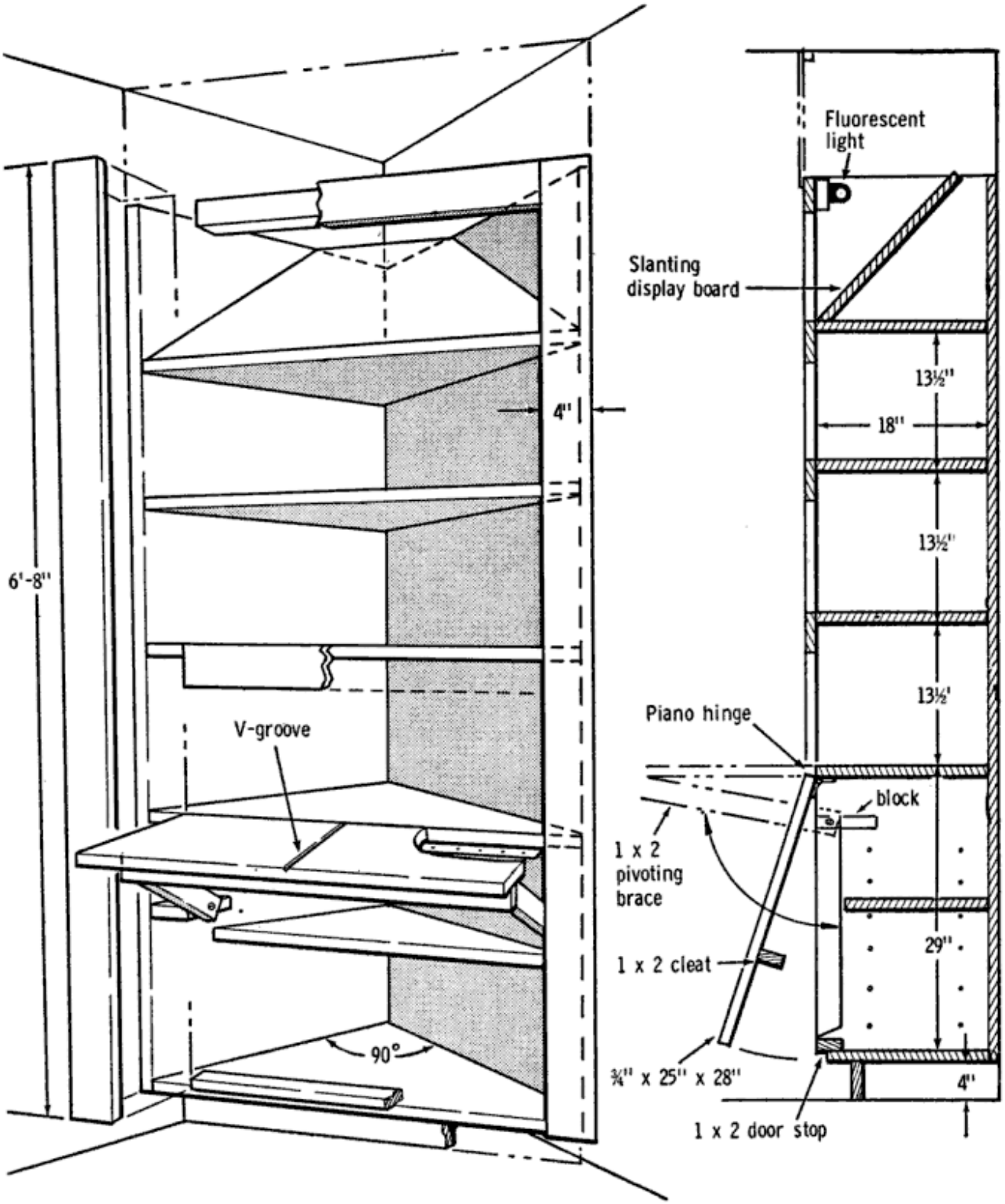

Would-be apartment hobbyists with no means of building anything could still come up with the in-a-corner collectors' "corner" by purchasing a readymade unpainted corner cabinet. Only a minimum of work would be required to revamp the lower part and add the novel false-door front which cleverly pulls up from the bottom to provide an instant worktable. Pivoted props support the table in a raised position and hang free inside the cabinet when the tablet lets down to pose as doors. A fluorescent lamp installed behind a valance at the top of the cabinet will set off a prized collection displayed on a slanting board. Aprons added to the front edges of the shelves may be plain or scalloped. The false doors are made even more deceptive by adding handles. The rock and gem display shown is part of an extensive collection of Ron Ashby of San Francisco, Calif. Original collectors' corner was made of Simpsons' California Redwood, with white Overlaid Plywood being used for the "doors."

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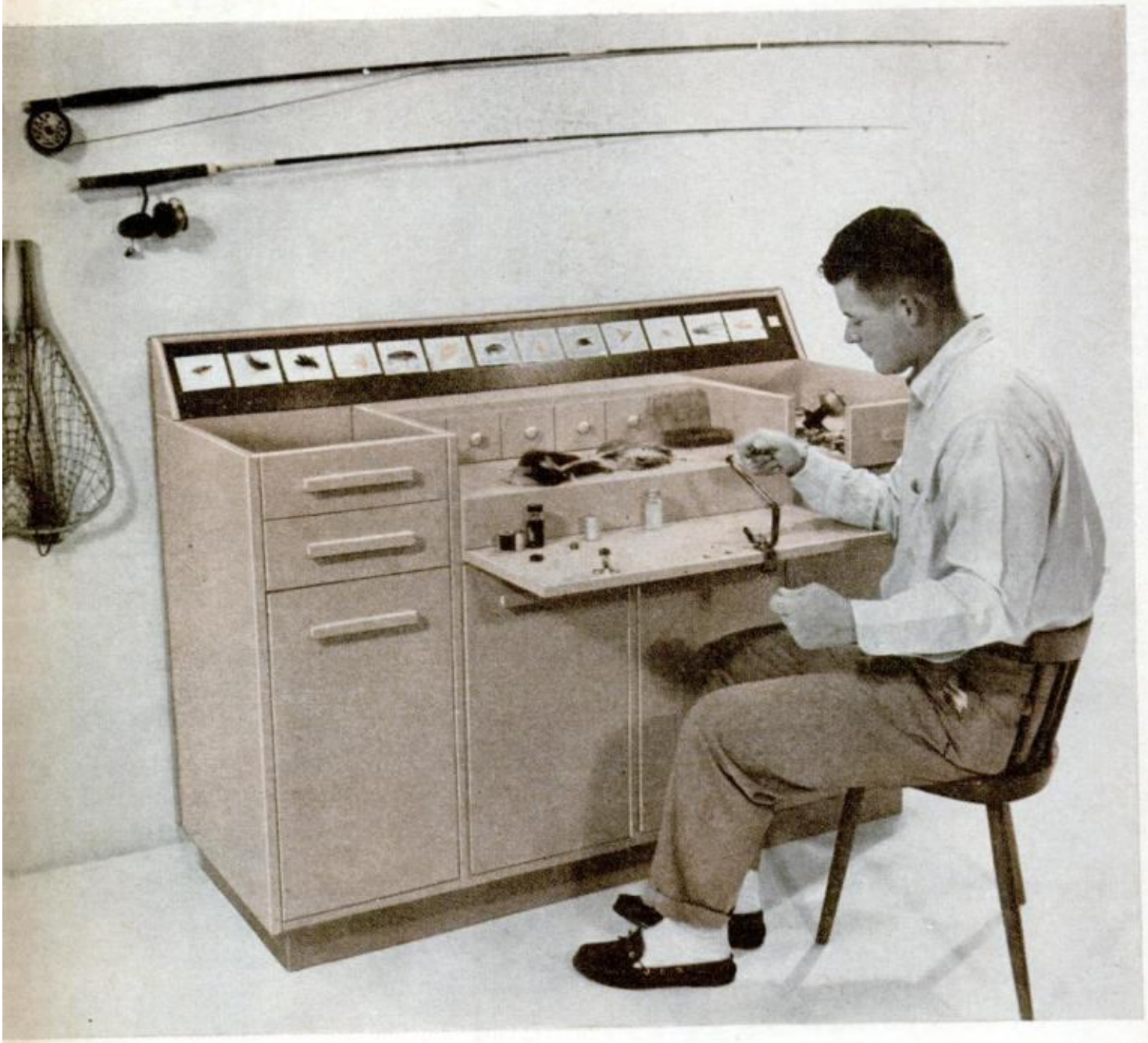
Hunting and Fishing Hideaway



movies like they do downtown. Both projectors are on standby on their own shelves behind the opening, and with the new automatic machines that boast remote controls, the home operator can sit out front in the comfort and company of his audience. A swing-up counter attached to the door, plus reel and accessory storage, again takes advantage of space that's there, but unused.

The collectors' hobby "corner" is just *that*, in that it makes use of the waste space of a corner which most every home has. Posing as an ordi-

(Please turn to page 226)

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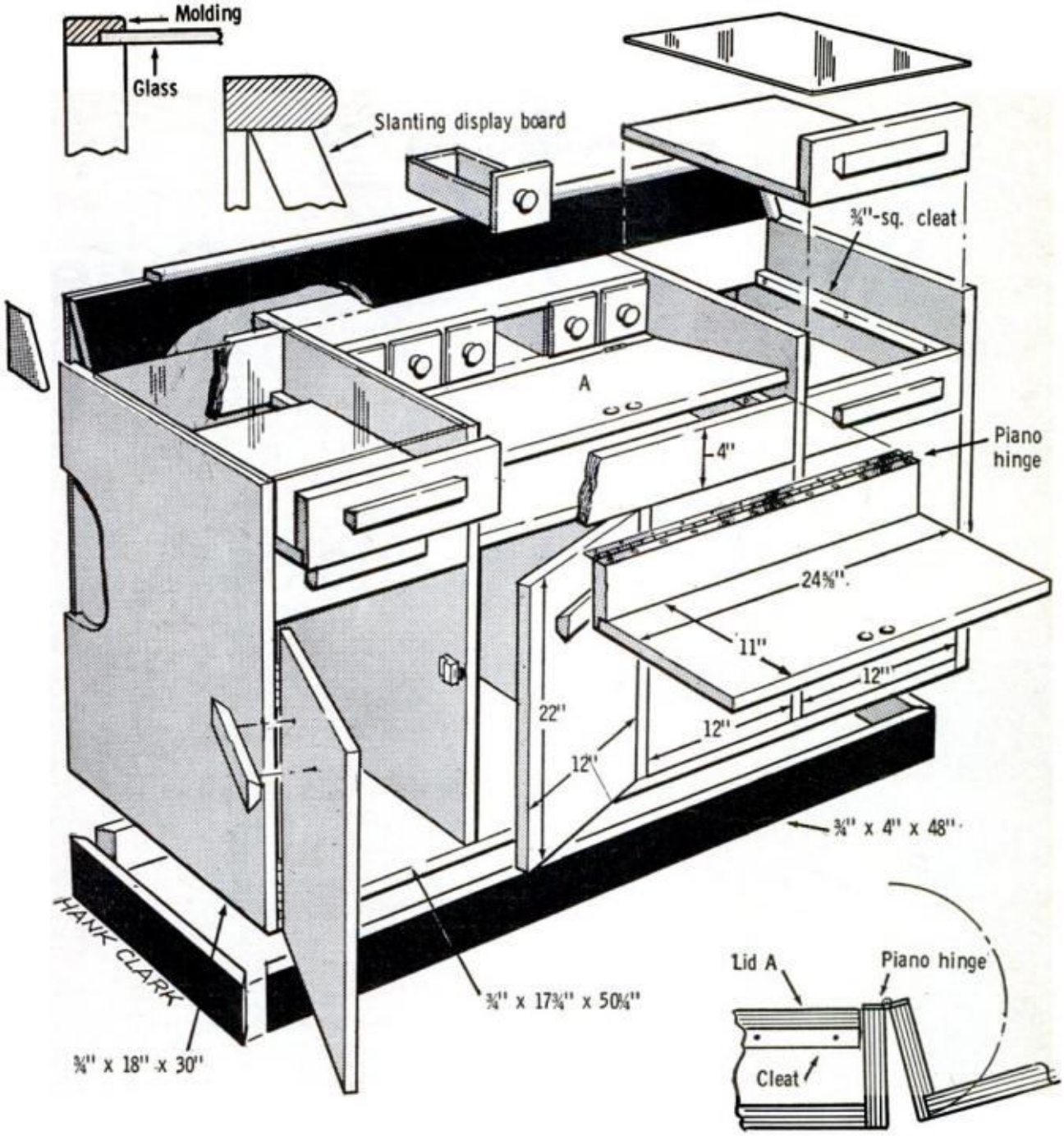

Sportsman's cabinet, an example of unframed, butt-joined panel assembly, is made of ¾-in. plywood, good both sides. Without resorting to tricky construction, it presents no less than 16 separate compartments behind its doors, lids and drawer-fronts. Six center drawers keep hooks and fly-tying supplies (or shotgun shells) closed up from Junior's reach. The flip-over L-lid is secured only by a piano hinge, butts against stationary top panel when closed, and needs no additional support when open since its rabbet joint is secured with glue and flathead screws; it's assumed that only light work will rest on this ledge. Beneath the L-leaf is a second lid, hinged to the base of the drawer section; it closes on two cleats and sets flush with the hinge edge of the front apron. Like the L-lid, it has ¾-in. holes drilled through it for finger grips. Handles on other compartments are wedge-shaped strips of 1-in. solid stock cut on the bench saw with blade set at 30°; you will need eight. Pull-out trays that flank flip-top are for display and easy selection of ties and lures (or hand guns). They rest and slide on side cleats. Tops of these sections are covered with plate glass, cut just wide enough to rest on edge at each side and secured with rabbeted molding, as shown in detail. Kick-plate base is formed of three mitered lengths of 1x4 stock.

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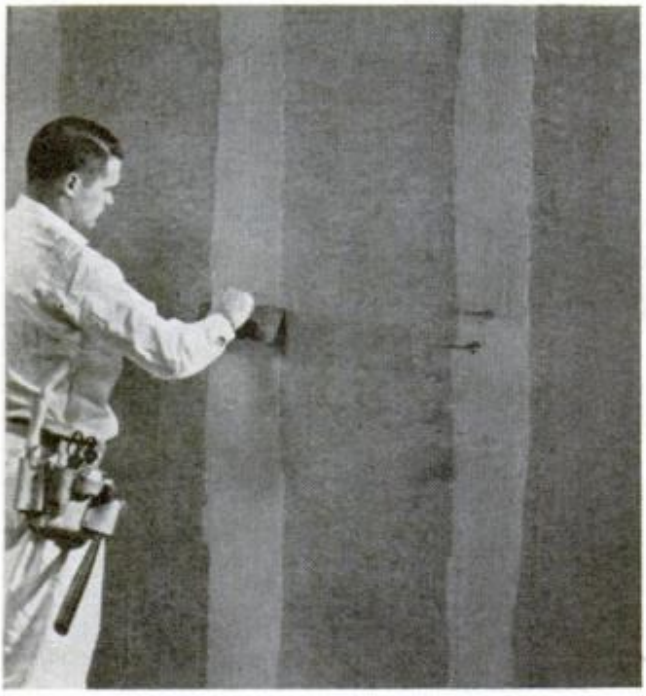
HOME SECTION

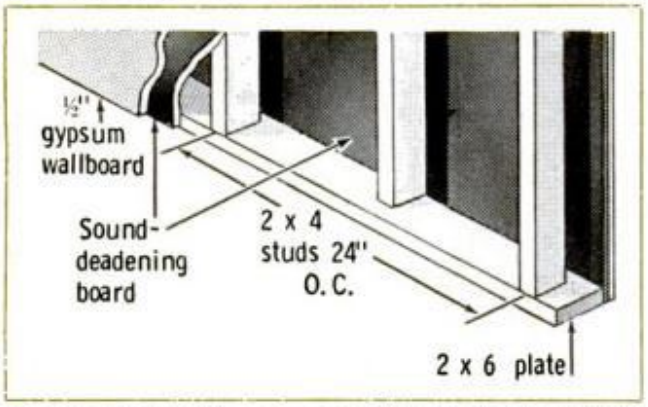
Wrap Yourself in Quiet

Today's homes are plagued with new noises—but you can use new soundproofing techniques to silence them, once you know the three ways noise spreads

Stop airborne noise



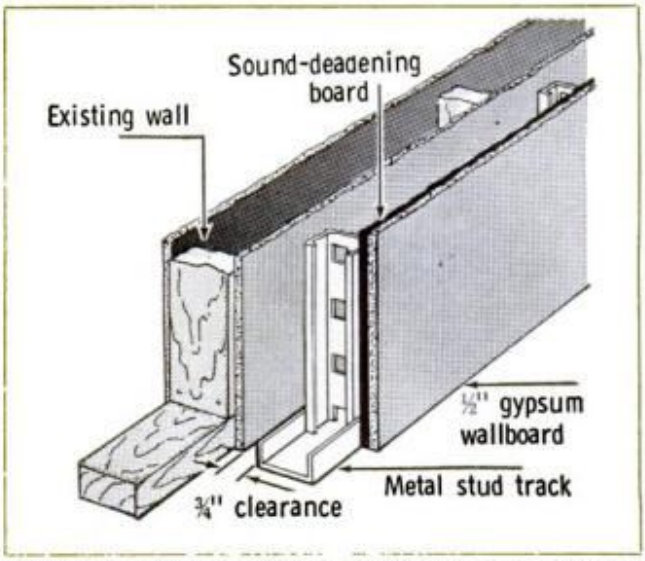
New panel board drinks noise like a sponge does water, lets you erect sound barriers. Nail sheets to studs, stripe with adhesive to take wallboard.



New partitions become sound barriers when 2x4s are staggered so wall faces won't have studs in common. Doubled face panels cut airborne sound.

PROGRESS! Think what the modern home can offer at the flick of a switch: the swelling burst of a symphony orchestra—in higher "fi" than you'd hear in a concert hall . . . the angry screech of a power saw biting through wood . . . the insistent buzz of appliances that turns the kitchen into a wasps' nest. However necessary (or even pleasant) such sounds may be to the person causing them, mixed together they spell *noise*.

Noise sweeps through your house in three main ways, the most common of which is *airborne transmission*. Sound waves spread out from their source like ripples from a stone tossed in a quiet pond. When they strike hard surfaces, they



Sound barrier can be erected alongside existing partition without much loss of floor space. One method uses metal studs erected in special track.

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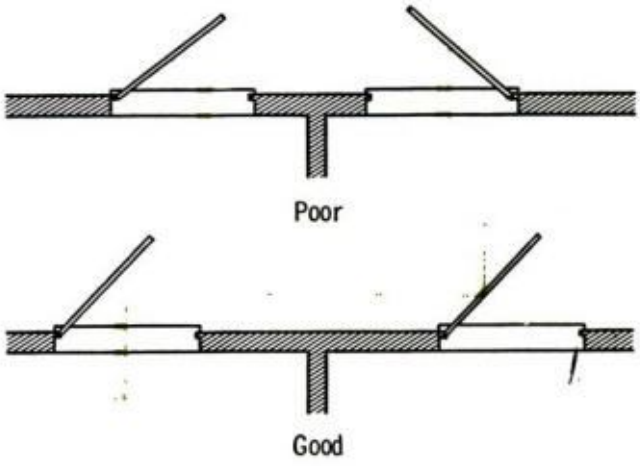
Acoustical ceilings are effective in absorbing sound within a room but do little to stop passage to adjacent rooms. For that, you must apply tile over suspended gypsum board—or use foil-backed tile.

reverberate back, but also set the wall surface vibrating. The opposite wall-face vibrates to match—like the skins of a drum—and thus the sound moves right on through the wall.

Meanwhile, the sound *within* the source room is amplified by being reflected back and forth between hard surfaces, extending its life and reinforcing itself. This is *reverberation* sound. Absorbent surfaces, such as rugs, drapes, upholstered furniture, soak up sound like a blotter, greatly reducing this multiple bounce. You've had a good demonstration of what such materials can do if you've ever moved into an unfurnished house or apartment. Remember how the bare walls and floor sent sounds ricocheting like bullets from a machine gun fired in a steel-plated cell? Once your soft, absorbent materials were brought in, however, these sound "bullets" had no "steel plate" to ricochet from; instead, when they struck the drapes or rug, they *sank in*. That's the principle behind acoustical material such as perforated ceiling tile. Those holes are noise traps that keep many of the sound waves from bouncing back at you. To offer effective traps, however, such material must be *permeable*, so sound can leak on through. That's why acoustical materials have little effect on sound *transmission* from one room to another.

To halt this, you must erect a sound *barrier*, and sound-deadening board is designed for this purpose. It's a special ½-



Careless details can wreck any soundproofing system. No matter how effective a barrier you have between rooms, close-spaced casement windows opening toward each other (top) will provide an easy detour. When they open parallel, however, the second may act as a baffle to bounce sound away from the house. Caulked and weather-stripped windows and doors reduce airborne transmission. No sound barrier should be pierced unnecessarily: insert units such as electrical outlets, heat ducts or medicine cabinets should not be placed back-to-back in the same stud bay, but spaced apart as shown in the sketch at left.

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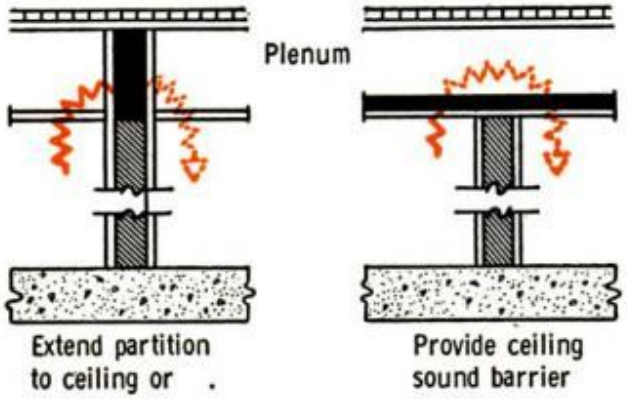

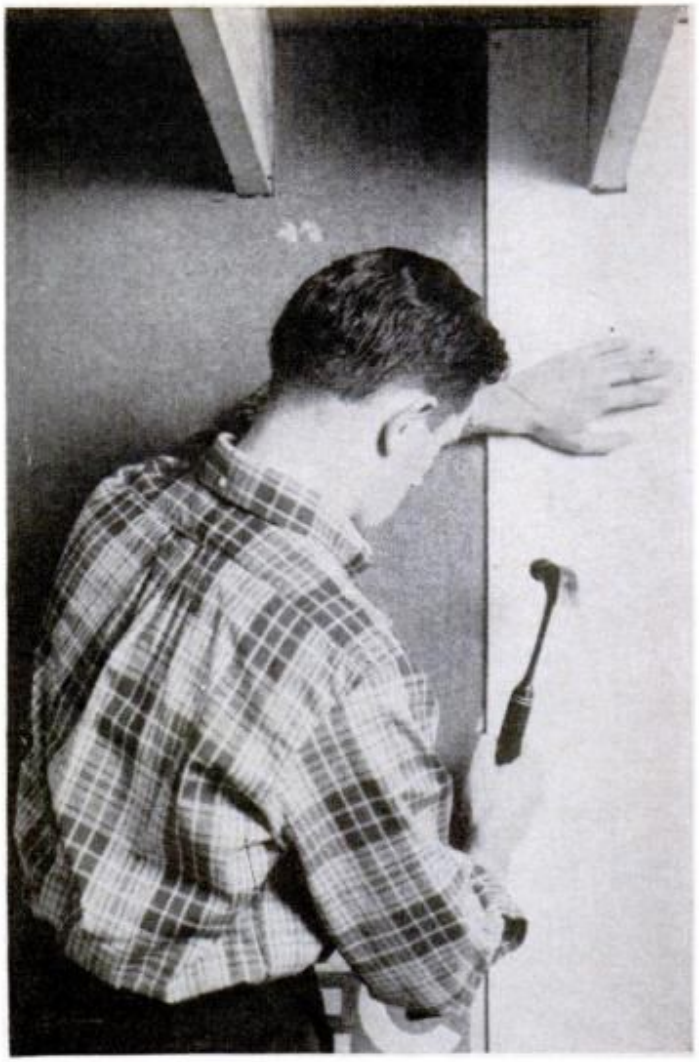

Dropped ceiling? To keep noise from leap-frogging to next room, either run partitions all the way up to underside of floor (left sketch and photo right) or create a barrier above the ceiling by applying tile over sound-deadening board. Note in photo that both sound-deadening and gypsum board layers are notched up between joists.

in.-thick insulation-type wallboard made from wood fibers, and comes in panels 4 ft. wide and 8 or 9 ft. tall. When nailed to studs with a layer of ½- or ⅝-in. gypsum board cemented on top, it creates the best sound barrier you can wrap a room in. But just like a *vapor* barrier, it must be continuous, with as few "leaks" as possible. A 1-sq.-in. hole in a plain non-soundproofed wall will let through as much noise as nearly 100 sq. ft. of the wall itself. So don't try to create a sound barrier with a loose-fitting hollow door in the wall!

• Stop structure-borne noise

THE SECOND WAY noise travels from room to room is through the structural members of the house—the studs and joists. As an example of this type of sound transmission, just remember how tenants in old apartment buildings used to rap on their radiators in inform the furnace room —many floors below—that they wanted more heat.

The way sound travels along a pipe—or a structural member—presents one of the biggest problems in soundproofing. Obviously you have to rest walls solidly on floors—you can't isolate one from the other with a spongy sound trap. But there *are* ways to isolate noise sources *from* the structure, and a few of these are shown at the top of the next page. Resilient material between pipe fittings and their structural supports lets the pipe move without creaking or binding. Pumps, washers and air conditioners should not only float free of their support on rubber or cork pads, but should be tied into water lines with a section of flexible piping. Rooms that have been separated by

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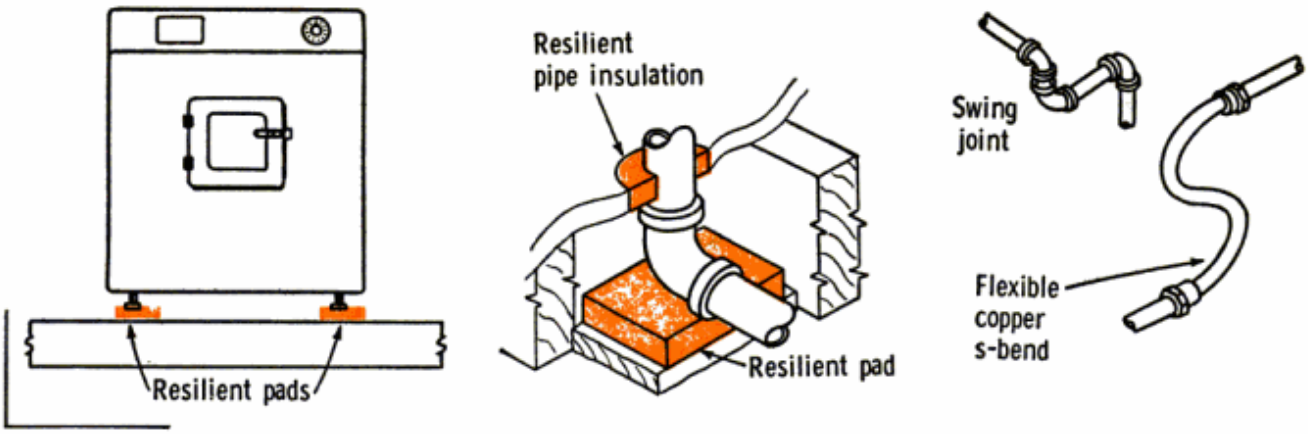


Some noise sources transmit directly to the structure of the house. Mount machines such as washers and pumps on pads (left) to absorb vibrations. Provide copper hot water pipe with expansion joints (right).

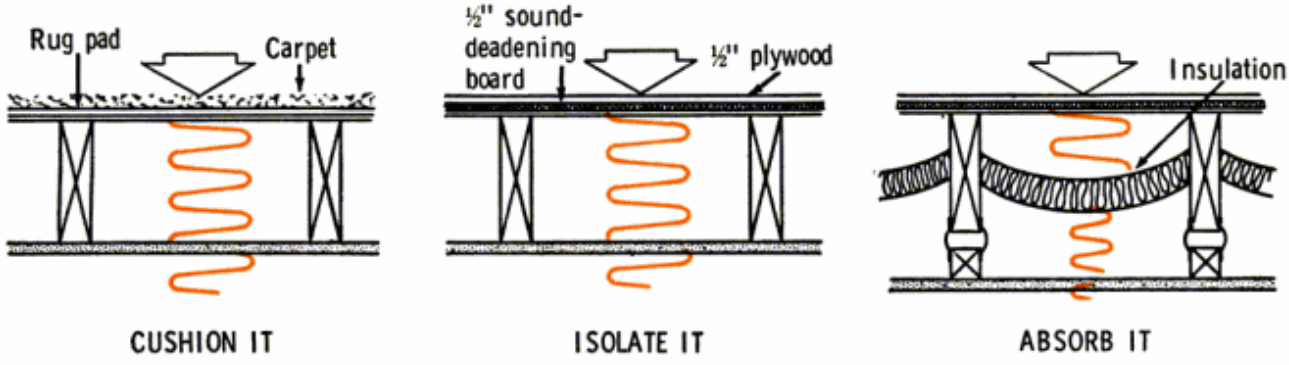
a sound barrier in wall or floor should not share a heating duct.

These are details. Even more important in stopping structural transmission are the basic techniques of *constructing* sound barriers. Staggered studs isolate the two faces of a partition wall so that sound vibrations can't pass directly from member to member. And ceilings can be suspended below floor joists so as not to "pass along" structure-borne sound. Special resilient clips let furring strips "float" out of contact with the joists they're hung from, creating a structural gap (as shown in the sketch at right, below, and detailed in the ceiling story, page 158).

Stop impact noise

EVER WAIT beneath a bedroom for the person up there to drop that other shoe? Here's an example of a home's third noise problem: *impact* sound. It's that noise that jabs at you when a floor or wall in an adjacent room is struck or a door is slammed. Actually, it's another type of structure-borne noise, but since it's mainly concerned with floor-through-ceiling transmission, the special silencing techniques demand a separate category.

The most common impact irritants are footsteps or furniture scraping on the floor above you. The most obvious means of dampening such sound is at the source: by cushioning the floor with carpet or resilient flooring. But the floor surface can also be isolated from the supporting structure (the joists, or the concrete slab in modern apartment construction) by sandwiching sound-deadening board between the subfloor and finish flooring. Or you can attack the problem from the opposite side by isolating the ceiling—that is, suspending it on either resilient clips, as shown below, or on independent joists. Where access to the joist spaces is available, you can further dampen both impact and airborne noise by stapling insulation across them, as shown.



Three ways to dampen overhead noise are: (left) with resilient floor covering; (center) with a sound barrier to isolate finish floor from joists; and (right) with porous blanket between joists, and "floating" ceiling.

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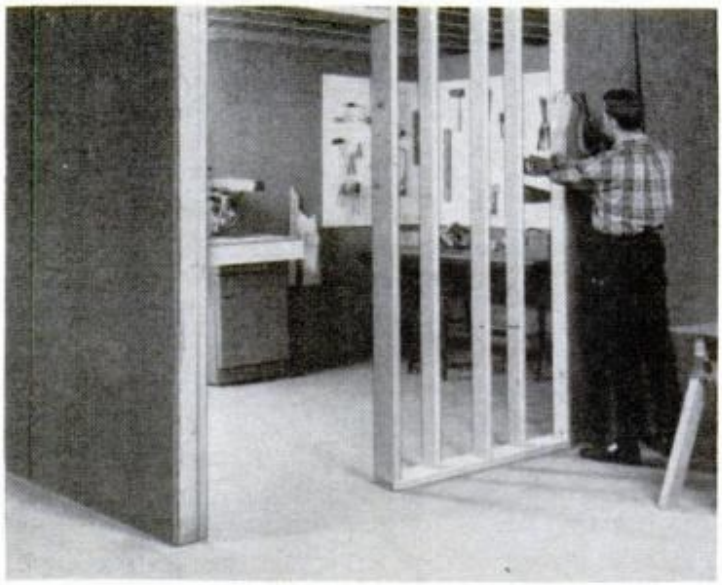
Now, let's put the principles to work...

Caging a roaring workshop



No longer will these power tools have the "run of the house." The cage that'll soon confine their snarls consists of 2x4 studs, staggered 24 in. o.c.

Certain areas of the house are a noise-nuisance by nature: the kitchen and bath, the playroom, and—worst of all, especially if you have power tools—the basement workshop. We asked National Gypsum Co. experts to show us how their Deciban sound-deadening board and Cush-n-Clip ceiling system could tame this noisiet corner of the average home. The basic ideas shown here can be adapted to other locations.

Sound barrier walls must be thorough. Joints of first layer are offset from those of second; this calls for oppositeL-shapes around doorway, above.

As the photo above shows, the "cage" is the staggered-stud framing we've already discussed, double-faced with sound-deadening board and gypsum wallboard, each ½-in. thick. The joints of these board layers must never align. Attach the sound-deadening panels vertically with GWB-54 nails spaced 24 in. o.c. along the edges. Stagger the joints on opposite sides of the framing. Now attach the wallboard panels with 8d coated nails spaced 12 in. o.c. and driven through the sound-deadening layer and into the studs. (An alternate method is to *cement* the wallboard in place by applying vertical stripes of laminating compound to the face of the sound board.) Stagger the wallboard joints on opposite sides of the wall, and offset them 24 in. from the sound board joints.

Finish all the wallboard joints with joint compound and perforated tape. Now, seal all joints between the new partitions and the floor and sidewalls with ordinary calking, and calk also around any outlets or pipes that pierce the wall.

The floating ceiling cross-sectioned above right is an automatic system that's easier to install than it looks. You tack furring strips temporarily along the bot-

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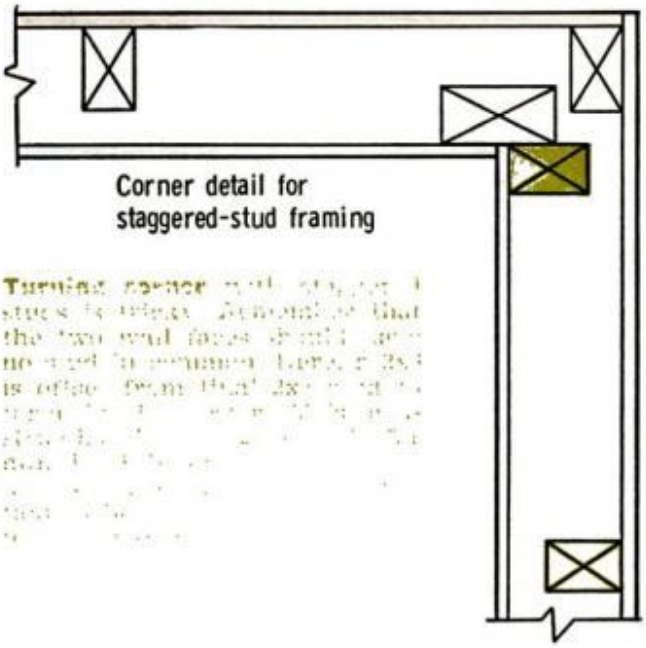

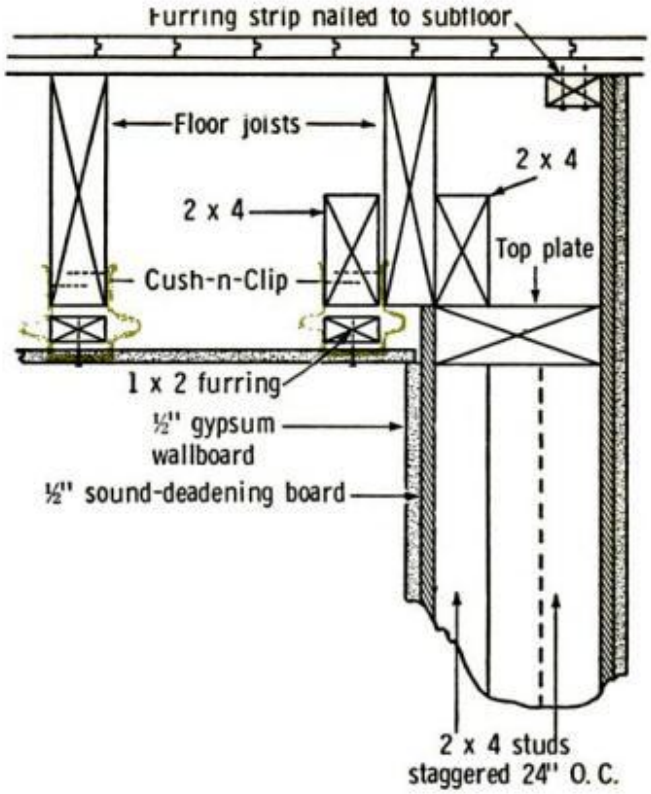

tom edges of the joists—*before* applying the finish wallboard layer inside the room. Next, fit the special clips over the furring and nail one leg to each side of the joist. The spacing is determined by the joist spacing. For joists 16 in. o.c., you'll need clips only every 24 in., but if the joists are 24 in. o.c., clips should be 20 in. apart. After applying them, remove the temporary nails from the furring and nail ½-in. gypsum wallboard to the strips with GWB-54 nails 6 in. o.c. (Nails can't be more than ⅛ in. longer than combined thickness of board and furring.) The perimeter of the wallboard ceiling should stop about ⅛ in. short of the face of the sound board.

Now apply your wallboard facing, cutting the panels short enough to fit between floor and floating ceiling without forcing. Apply molding at the ceiling line to finish the job.

Now: switch on those growling, screeching beasts you've caged. Sound louder than ever? That's because much less noise is *escaping* to adjacent areas. To control this confined sound, you may want to add acoustical tile to the wallboard ceiling. If so, install these before you add that inner gypsum layer.

Wall-floor joint should be sealed with calking before base molding is nailed through to sole plate; sound would leak through any gaps here.

Door and trim must be snug. Fit molding to seal cracks between frame and wall. Retractable weatherstrip drops against floor as door closes.

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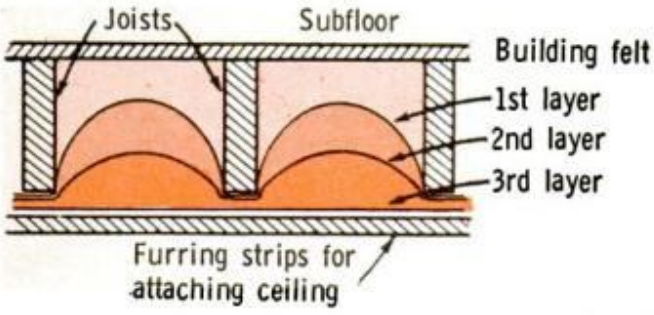
Sealing the ceiling

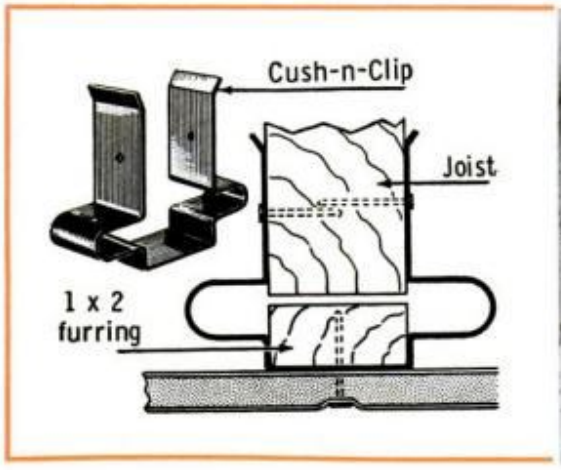
One-man application of rolled building felt is possible if you nail up rough rack of 1x2s to push across room. Roll spins on loose top bar.

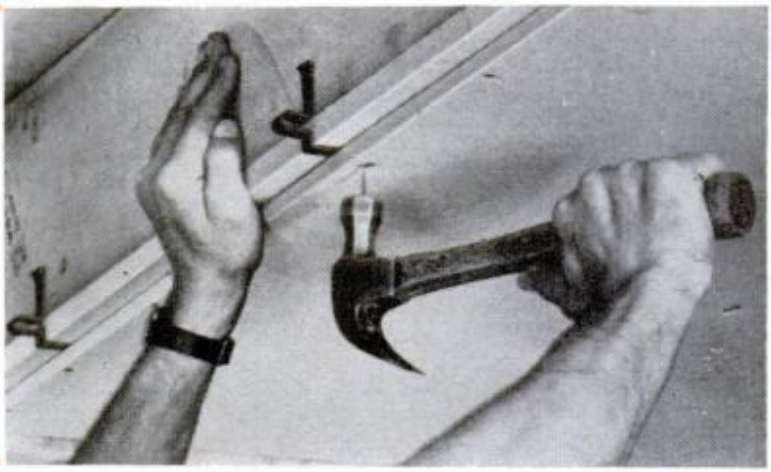


Final layer is stretched flat across bottoms of joists, then standard furring is added, either at right angles to joists or along their edges.

Most people's idea of "sound treating" a ceiling is to apply acoustical tile. But as we've pointed out, this material is designed to dampen noise originating *within* the room, not to prevent passage upward *from* the room, or downward from a noisy room overhead. Yet most ceiling treatments are concerned with keeping sound that originates in downstairs areas, such as rumpus rooms or workshops, from surging up into the living or bedrooms above.

One method of "sealing ceilings" against sound passage was discussed on the previous page, and is further illustrated in the sketch and the photo below. A different treatment is demonstrated at left. Clifford Fenner of West Vancouver, B. C., found that curved layers of building felt between overhead joists cut down on sound transmission. The heavier the paper and the more layers of trapped air, the more effective the treatment. The first strip is merely unrolled across the joists and bellied up into each bay until the apex of the curve is within an inch or two of the subfloor. Staples into the joists hold the scalloped shape. The next layer is bellied less deep, to leave an air pocket between it and the first—and so on. At cross-braces and walls, lap, clip, fold and staple the felt to create a seal. After furring is nailed over the flat final layer, a finish ceiling of wallboard or tile can be added for a neat, low-cost way to put the lid on basement noise.





Special clips that "float" ceilings (as described on previous page) come in two sizes: for standard 1⅝-in. joists and 3¼-in. double joists; they're available from building supply dealers. When wallboard is nailed to furring, as shown in photo at right, it drops into suspension by its own weight, creating gap between furring and joist to block passage of structure-borne sound.

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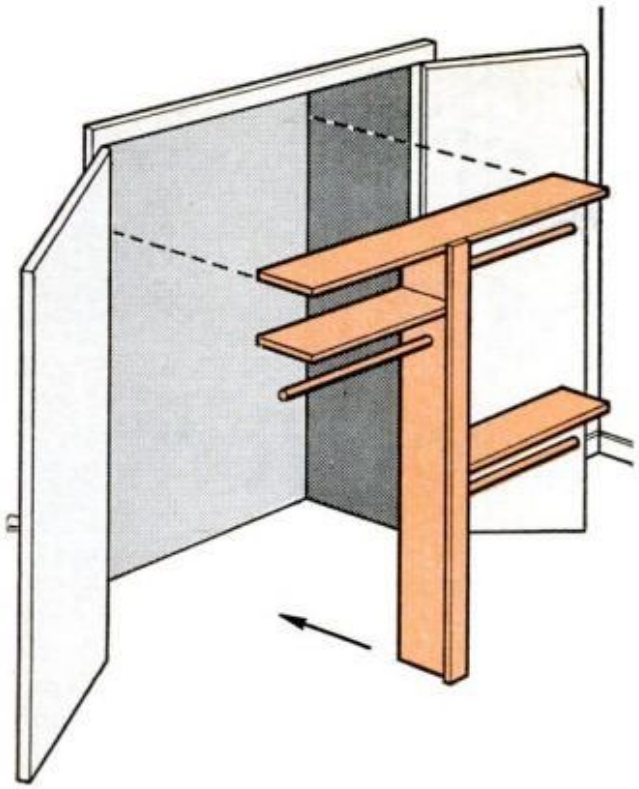
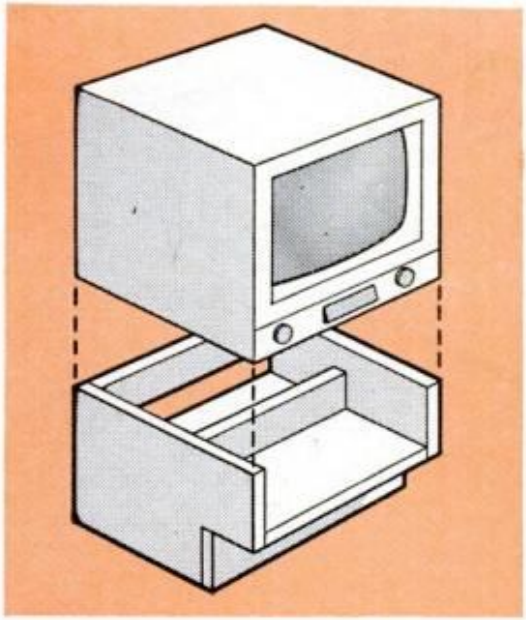


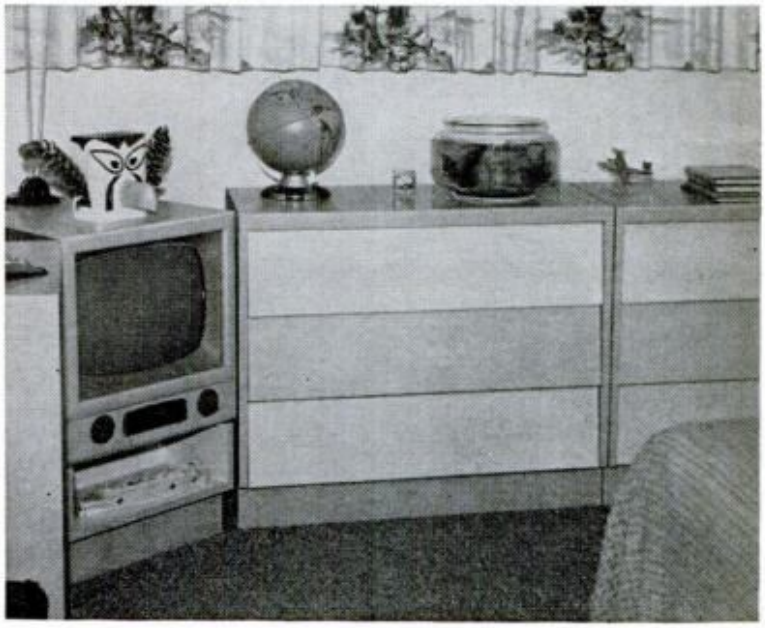
Don't Curse at That Old Closet—S-T-R-E-T-C-H It

You can double the capacity of almost any closet by merely adding a couple of shelves and clothes bars—provided you arrange them properly. In this double closet, for example, a typical one-shelf, one-bar set-up was replaced by three shelves and three bars. A divider now separates the closet into two compartments. In one, a bar 72 in. high stores full-length garments. In the other, two bars—36 and 77 in. high, respectively, now store more jackets, shirts and other short items than the whole closet did before. Finally, a pegboard rack on one door holds belts, ties and the like.

Old Television Sets Don't Have to Die or Fade Away

After we bought new living room furniture, our old table-model TV set no longer matched the room's decor. Since the set still played well, rather than throw it out we converted it to a console model by setting it on a homemade base like the one shown below. While this idea will work with just about any small set, you'll have to work out the dimensions to fit your particular one. The built-in display niche makes the base doubly useful and helps to add a decorative touch.—*Don Anderson*





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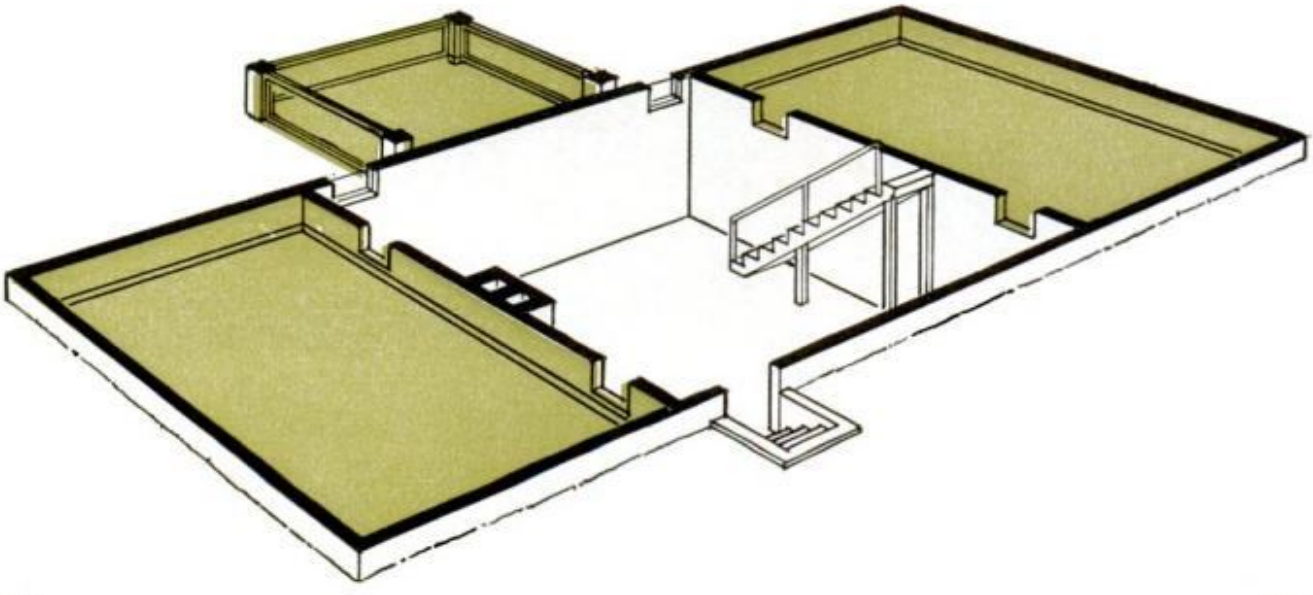
HOME SECTION

6 Ways to Put Crawl Space to Work

WHERE TO STORE the hundred and one things that are a part of modern suburban living is everyone's problem in raising a family and maintaining a home—there just isn't enough storage space, at least so it seems.

In many cases it's true; in others, however, there's potential space that's actually going to waste—lazy areas called crawl space that could be put to work to take care of the overflow. Unexcavated space under a part of the house, as well as space under a porch, is rarely considered, yet there's ideal storage space here for bulky items that are used only occasionally, such as your extension ladder, lawn roller, yard sweeper and spreader. Crawl space creates ideal storage, too, for many out-of-season items, such as storm windows and screens, folding patio furniture, barbecue grill, sleds, wagons and trikes, snow shovels, games and sports equipment, and dozens of other living essentials.

In converting any crawl space to storage it's important to first see that the earth floor is covered with a waterproof membrane of plastic sheeting or 55-lb. roofing felt to provide a moisture barrier. Such waterproofing material should be lapped at least 6 in. and extend up the foundation an equal amount. Usually, this is already done in the case of a crawl space under an unexcavated wing or room addition. Here, access to such space is generally from the basement through an opening left to provide necessary ventilation to the area, and as long as the opening is left partially open at the end, the crawl space can be put to use by building-in an open-end rack, or rigging a pull-out shelf that rolls on sliding-door hardware attached to the ceiling. Such an overhead rack is ideal for parking out of sight countless small items. In the case of an open-end pigeon-hole rack, it makes the most of the depth of the space when the rack is used to store screens, long-handled tools, and odds and ends of lumber.



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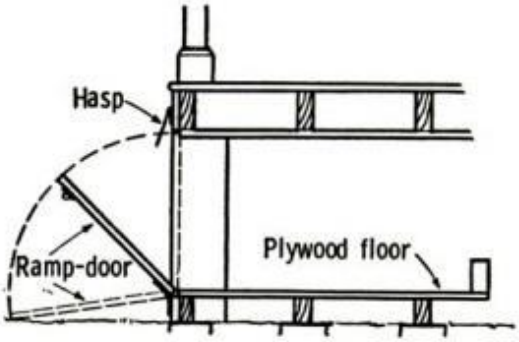
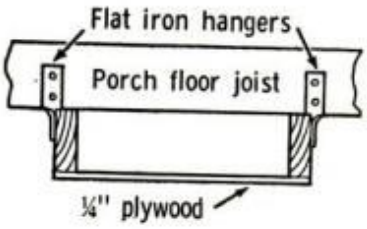
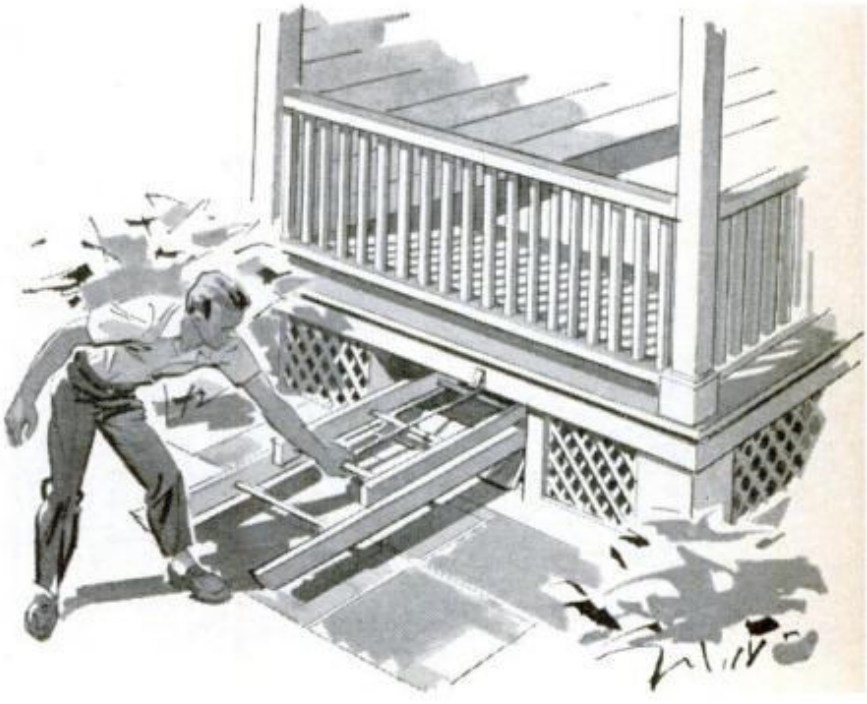


Parking a lawn roller or mower in an under-the-porch shelter, either in or out of season, not only keeps it extra handy to the yard, but gets rid of two big items that rob the average garage of a lot of vital storage space. Here a shelter is formed by nailing a floor to 2 x 4 supports and fitting it with a stop cleat across the end. The supports should be placed on bricks to protect them from wood rot, and any plywood used for the floor and door should be of the exterior kind since it will be subject to moisture. The let-down door serves as a ramp for easy wheeling and is fitted with a hasp and padlock to "keep the horse from being stolen from the barn."

2 **An item** that creates a real storage problem for most homeowners is a long cumbersome extension ladder. What can you do with it? Hang it on a wall and strain yourself putting it up and taking it down; and even so, if you don't have a garage, who wants it hanging across the back of the house? Again, the waste space under a long porch makes an ideal place to store it, without having to lift it to take it out and put it away. Here, to keep it off the ground, a "tunnel" is formed for it by hanging a trough affair from the porch floor joists and fitting this with a drop-down door. Side rails of 1-in. lumber, bridged with a panel of plywood, are hung at right angles to the joists with twisted metal plates screwed to every other one.





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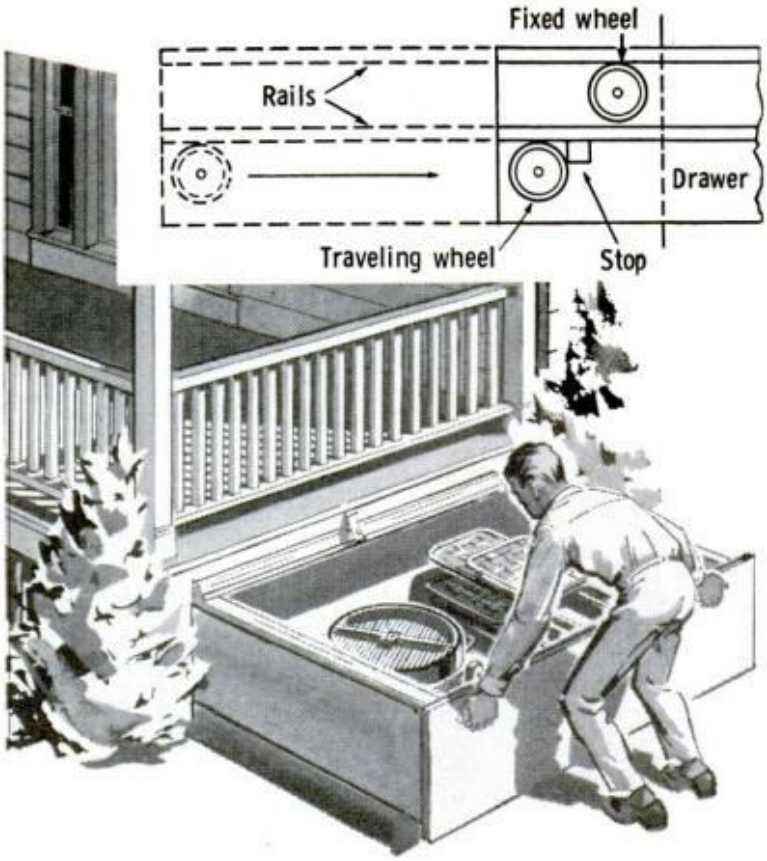
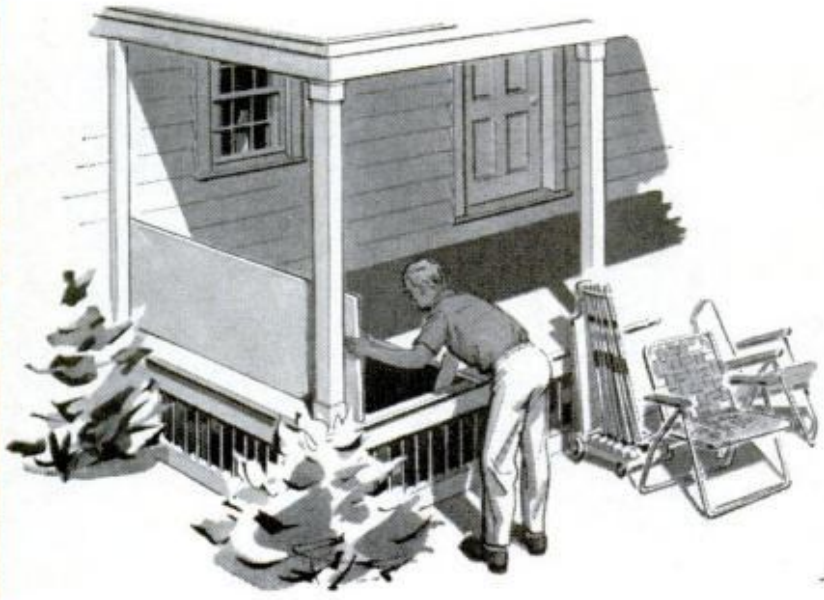
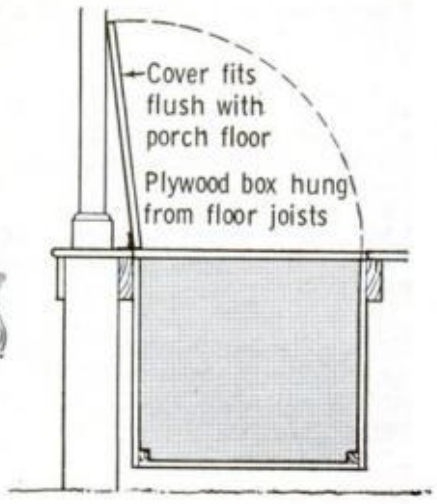


3 **A king-size drawer** rolling out from the open end of porch crawl space provides practical storage for many bulky yet lightweight out-of-season items, such as your portable grill, outdoor game equipment, folding patio furniture and the like. Built to span the full width of the crawl space, the drawer is made like a conventional drawer, using ¾-in. exterior plywood and fitting it with chest handles. Corner irons on all inside corners will help strengthen the drawer against the load it will carry.

Despite its size, the drawer can be made to roll easy as pie by fitting it with jumbo roller slides patterned after regular drawer hardware. Here 5 or 6-in. rubber-tired, coaster-wagon wheels provide king-size rollers. As the details show, one wheel on each side is attached to the drawer at the rear so as to travel with the drawer. The second wheel, located at the front and on which the drawer actually rolls, is attached to the porch structure and remains stationary. With this arrangement the fully-loaded drawer can be pulled practically all the way out without tipping down. It's easy enough to add a hasp and padlock and a stop block attached to the lower rail prevents the drawer from being pulled free of the runners.

4 **Where it's not feasible** (because of foundation plantings or other reasons) to make use of crawl space from the open end of a porch, access can be made through a trap door in the porch floor. Boards removed from a section of the floor are made into a matching trap door by nailing battens to the back in typical barn-door construction. You'll have to remove one intervening floor joist to give you at least a 24-in.-wide opening. The storage bin itself is simply a coffin-shape box of ¾-in. exterior plywood which is hung above the ground by nailing the plywood sides to the outside faces of the two border joists. The bottom of the box is strengthened with cleats along the joints. The hinged door rests flush with the porch floor when it closes on top of the joists. To protect the contents from water entering through the joints of the boards in the trap door, the underside of the door can be covered with a waterproofing membrane.





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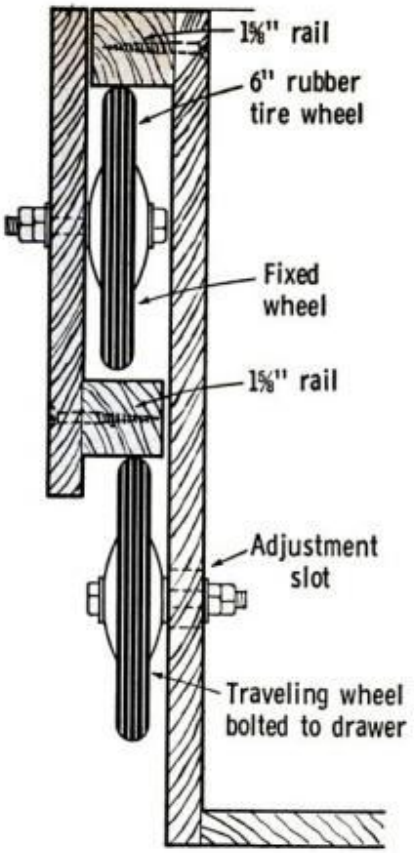
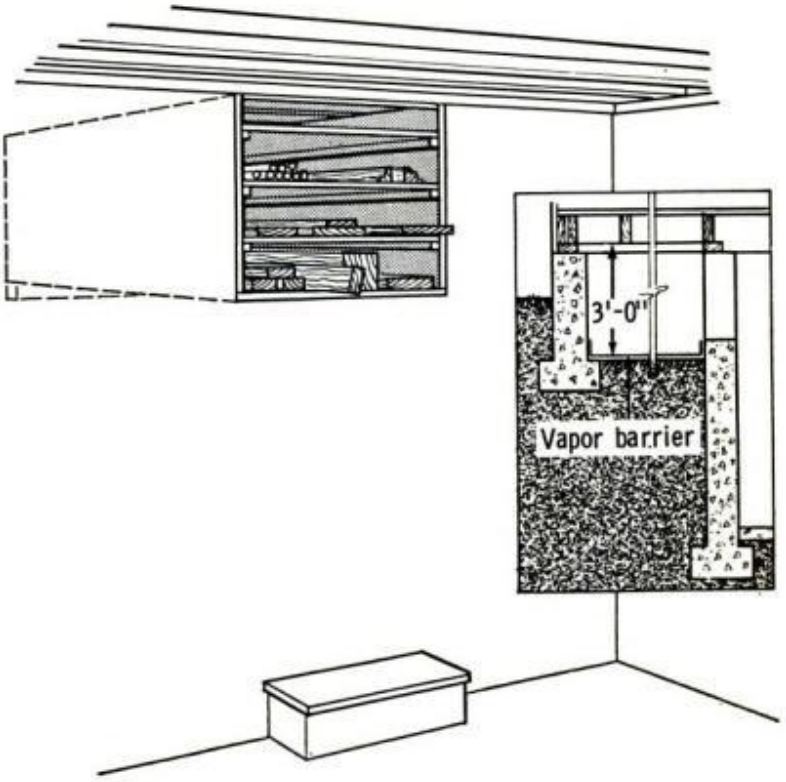
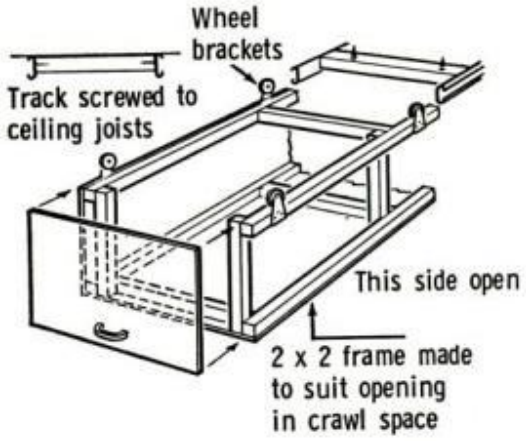


5 **Unused crawl space** under a room addition of the house is always put to best use when you take advantage of its depth to store long items. Odds and ends of lumber, for example, create a storage problem in a basement workshop and crawl space provides an ideal solution as to what to do with it to get it out of the way, yet keep it handy. Long-handled, out-of-season garden tools, as well as snow shovels, are other storage problems which crawl space will take care of. If the opening to the crawl space is wide enough, window screens and storm windows can be tucked back under to keep them safe from damage during their hibernation.

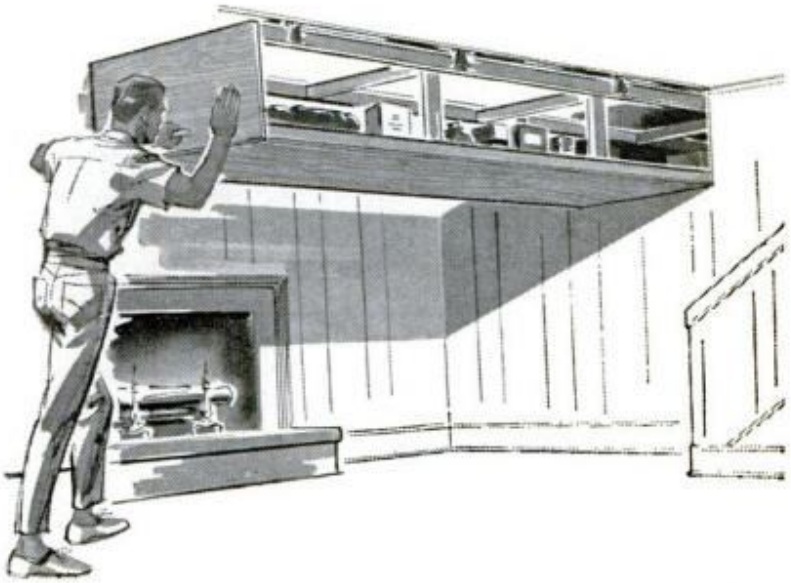
Of course, rather than just tossing such items in the opening, you'll have more orderly storage if you take the time to build a long open-end box to fit the opening and add pigeon-hole shelves. By leaving the box open at both ends, the crawl-space opening will still provide desirable cross ventilation to the unexcavated area.





6 **Where you have crawl space** under an area of the house which is only accessible through an opening provided in the basement wall, there are several ways you can make use of the 3 ft. of head room generally found in unexcavated areas. One is a rolling storage rack which pulls out like a drawer on a track screwed to the ceiling of both the basement and the crawl space. Such a rack will hold an array of small items—countless cans of paint, tools, packages of this and that, all the "junk" items that are too good to toss out or that may come in handy some day.

The detail shows how such a rack can be framed from 2 x 2s, then covered with plywood and left open on one side. Regular closet-door track hardware is used to guide the rack in and out of the crawl-space opening, and its length is limited only by the depth of the unexcavated area and the unobstructed ceiling area of the adjoining basement room.



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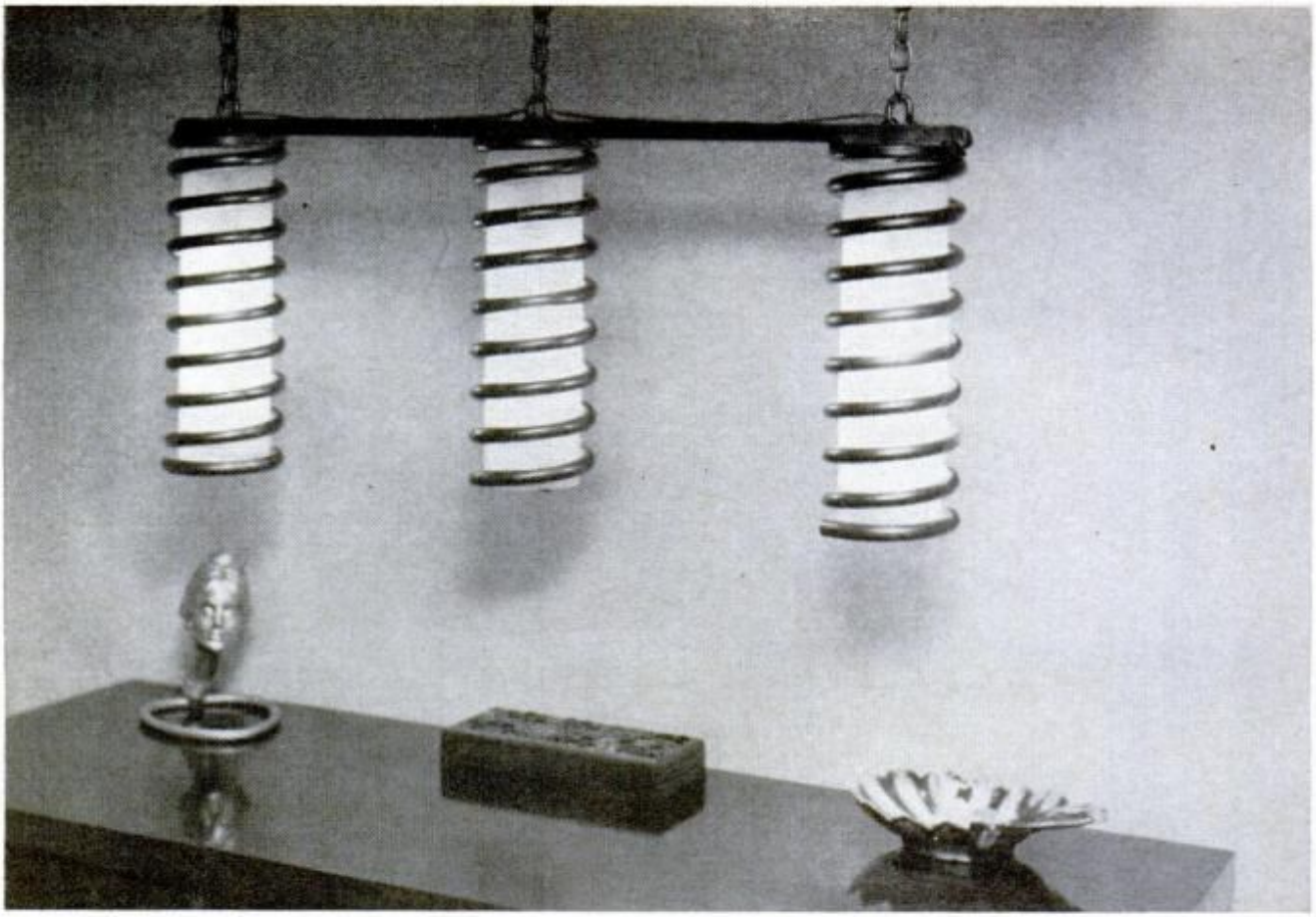
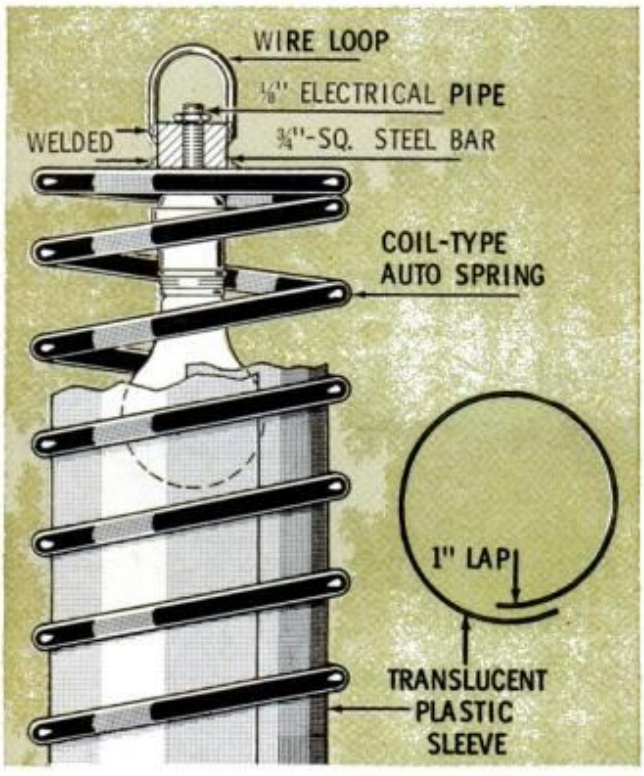


HOME SECTION

3 Smart Light Fixtures



YOU'D pay a pretty penny in a store for any one of these smart light fixtures, yet they cost only "pennies" when made from such common items as auto coil springs, plastic cake covers and electrical fittings.

Robert Shaffer of Canyonville, Ore., made the attractive spring fixture shown above, from coil springs from junked cars. When three springs are joined together by welding them to a horizontal bar, then sprayed copper and fitted with white plastic liners, you wind up with the most stunning fixture you ever saw. The detail at the left shows how the sockets are attached and the wires are brought through holes drilled through the bar.

Equally stunning are the two ceiling fixtures made from inexpensive plastic cake covers sold in variety stores. Designed by Joseph Braunstein, Forest Hills, New York, one fixture makes use of the whole cover, while the other uses just the tray. The detail shows how you add the sockets using standard fittings.

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Both cover and tray are used to make this elegant fixture. Locknut on end of center post permits cover to "hang" ¼-in. below tray to provide necessary ventilation. Hole is drilled through knob of cake cover for pipe post.

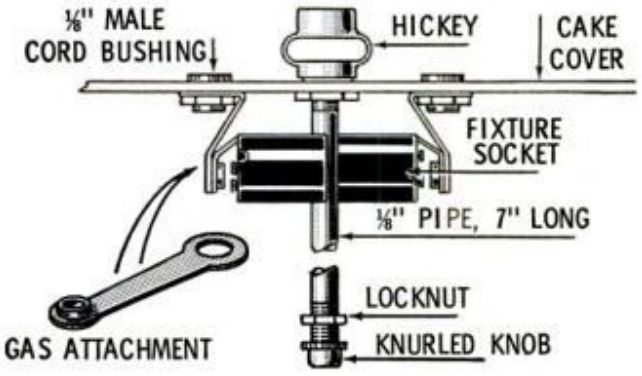

Photo above and drawing at left show how sockets are attached to tray. Center post holds cake cover in place, while tray is attached to existing outlet (flat against ceiling) with standard pipe nipple and hickey.

By using just the tray of the cake cover and attaching a two-way, standard-base socket to the center with a nipple and knurled knob, you can make an attractive ceiling fixture which can be simply screwed into an overhead socket. Being of plastic, there's no problem in drilling holes for nipple.

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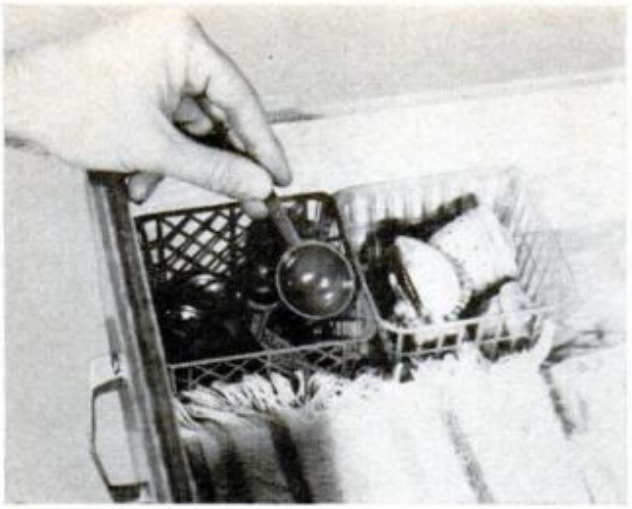
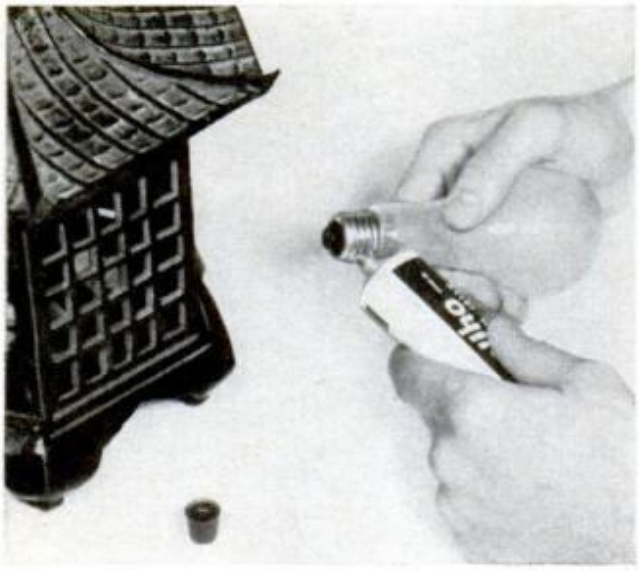
HOME SECTION

Solving Home Problems

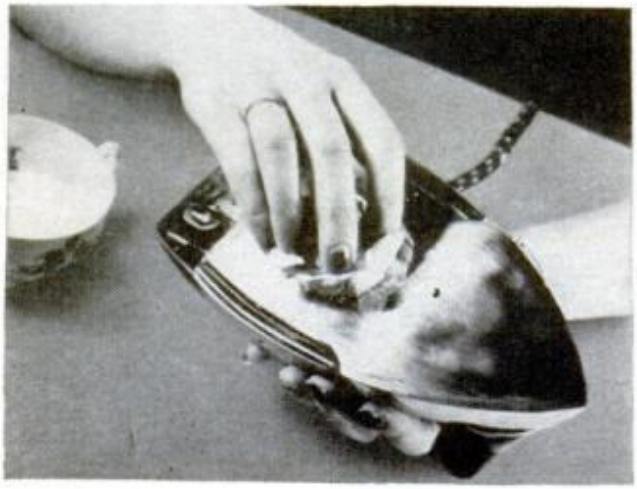


Get rid of the jumble in kitchen drawers by adding handy lift-out bins to hold small items. Those small plastic baskets in which berries are sold will work fine. They're light and easy to clean.

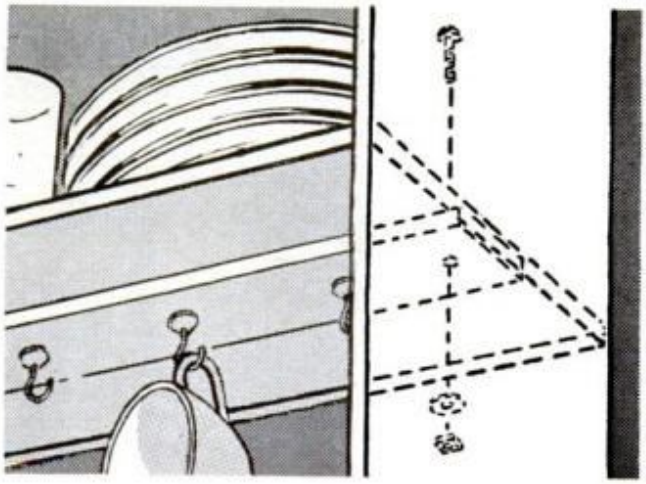


No need to worry about light bulbs in outdoor fixtures corroding into their sockets if you give the threads a light coat of petroleum jelly before installations. It makes a good moisture barrier.

Make your own no-scratch pads for lamp bases, ash trays, etc., from adhesive-backed foam sheets. Sold as a cushioning material to relieve foot troubles, sheets can be cut with household scissors.



Renew that glasslike finish on an old iron by rubbing with slightly dampened salt and a crumpled piece of paper. This will not only smooth scratches but remove corrosion and starch from the bottom.



There's an easy way to install cup hooks in a metal cabinet. Just cut a piece of narrow ¾-in. stock to fit under the shelf, finish it to match cabinet, install hooks on this and bolt it under shelf.

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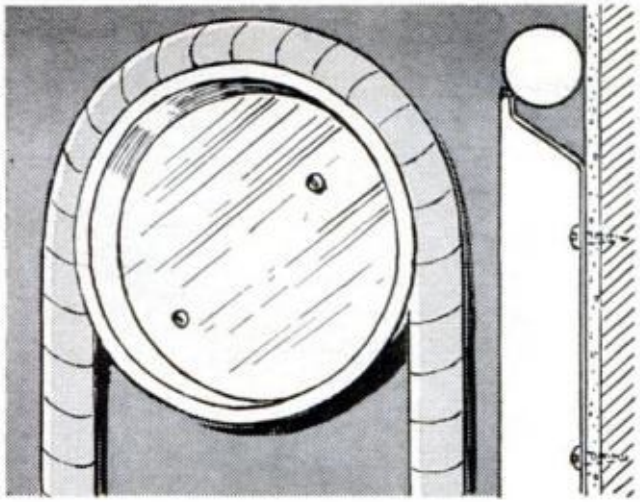
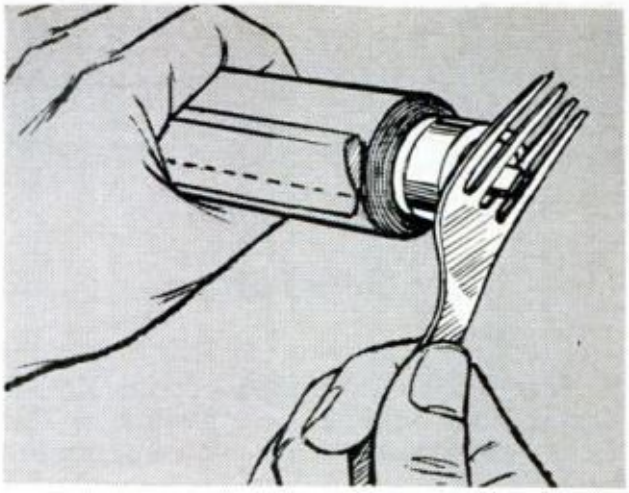
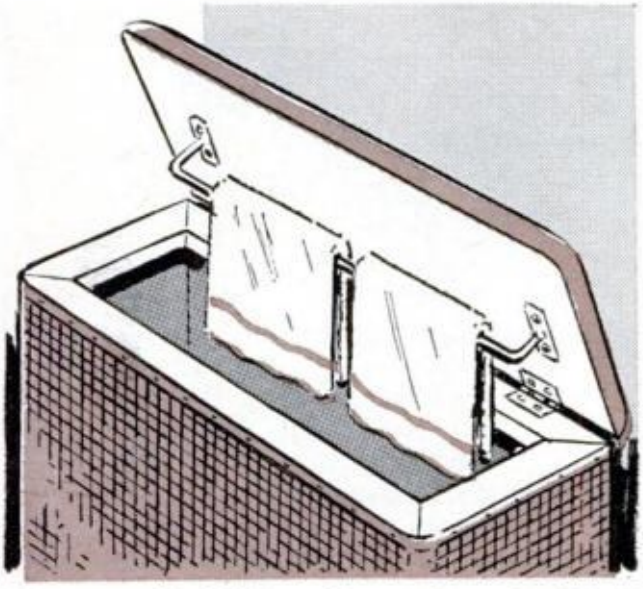


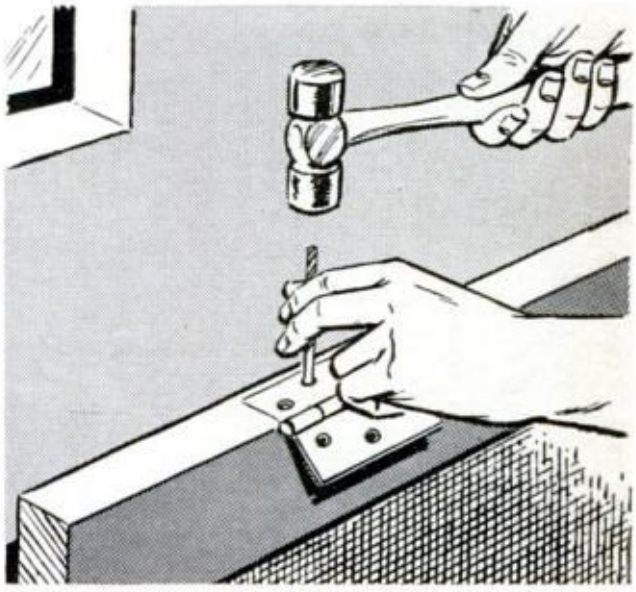
Strain-free storage fixture for a vacuum cleaner hose can be made by mounting a deep-dish pie tin on the wall of your broom closet. This way, weight of hose will be distributed over a smooth curve.



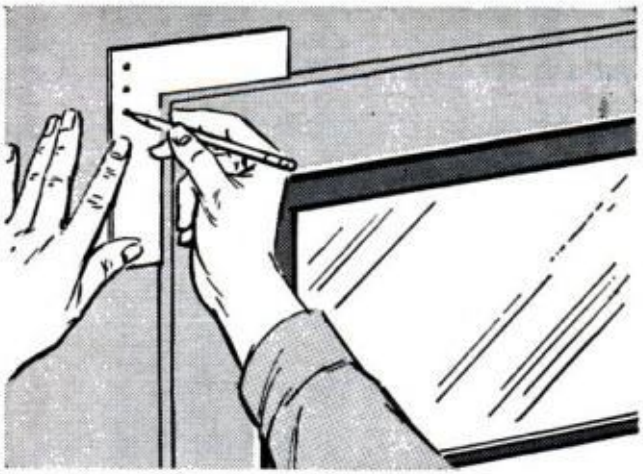
Ideal winding key for increasing the spring tension in a window shade is a common table fork. Slip the flat shaft between the tines and turn the fork. It's a lot easier than using pliers or wrench.



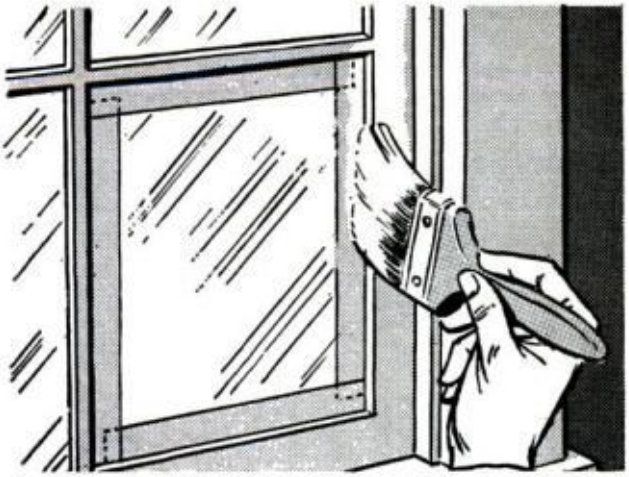
If you mount a light towel bar on the underside of the top to a clothes hamper, you'll have a rack for wet articles of clothing headed for the laundry. It's extra handy for holding those wet wash cloths.



When mounting a hinge, you can mark perfectly aligned holes by using the shank end of a drill bit as a center punch. Use a drill of the same diameter as holes and tap with plastic or wooden mallet.



To save time when installing traverse rods, make a simple cardboard template which will allow you to mark all of the necessary holes in seconds. It also assures alignment of the rods with windows.



Use precut strips of masking tape to protect panes when painting window sashes and the job will go faster. These should be slightly shorter than length and width of the panes and cut square.

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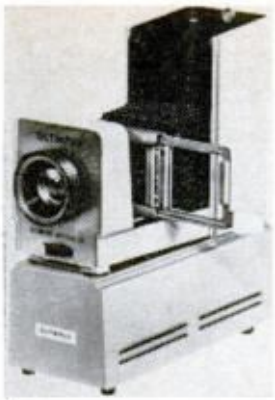
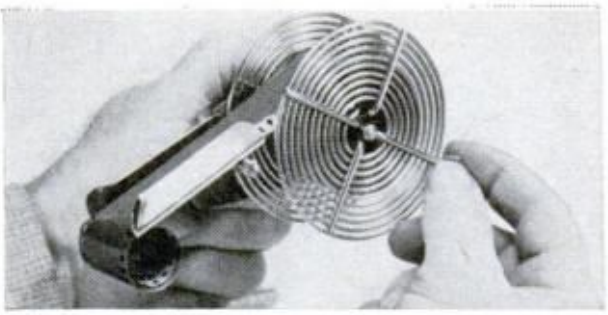
By Bob Berger

A New Updated Version of the Kodak Master Photoguide is now available. The pocket-sized reference book contains information on filters, lighting, exposure factors and many other technical aspects of photography. It sells for $1.95. Eastman Kodak Co., Rochester, N.Y. 14650.



Designed Especially for single frame slides, the Pen Projector II, fills a 30 x 40-in. projection screen at only 8 ft. The unit also accepts conventional 35-mm slides. Priced at $39.95, accessory blower costs $10, slide changer is $10.95. Scopus Inc., 257 Park Ave. South, New York, N.Y.

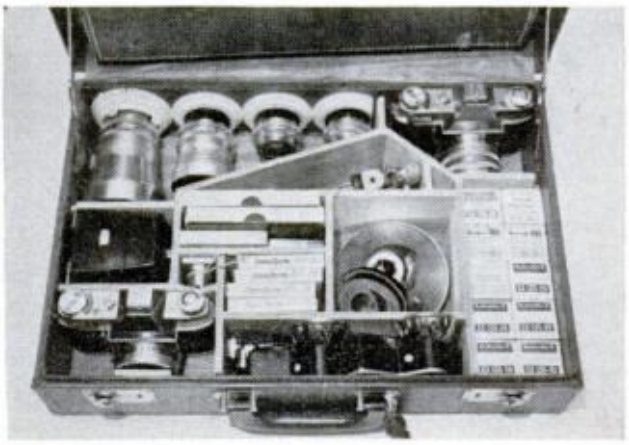


Film Reel Self-Loader eliminates all sorts of film developing bugaboos—kinks, scratches and fingerprints. The unit sells for $3.95 and is made in three models for 35-mm, 120 and 127 film. Ehrenreich Photo-Optical Industries Inc., 623 Stewart Ave., Garden City, N.Y. 11533.

Photo Shortcuts

WHEN YOU NEED extra tanks for holding film processing reels, try empty cottage cheese containers. Since the containers are not light-tight they must be used in total darkness or for processing operations such as washing, that are performed in room light

HERE'S A NIFTY WAY to keep all your photo gear ready for instant use. It's easy to make because you start out with an attache case and the only remaining work is to fit in partitions made of ¼-in. plywood to suit your particular camera, lenses and accessories



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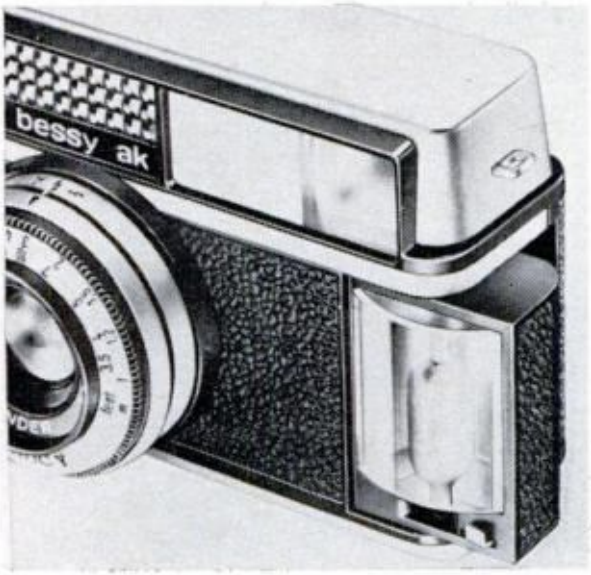
You Can Increase the projected image size of your color slides by 2½ times with the Tiffen Full Screen Projector Lens. It attaches to the rear of the original lens and shortens its focal length to increase image size. Price is $14.95; the lens is available in models to fit many popular projectors. Tiffen Optical Co., 71 Jane St., Roslyn Heights, L.I., N.Y.

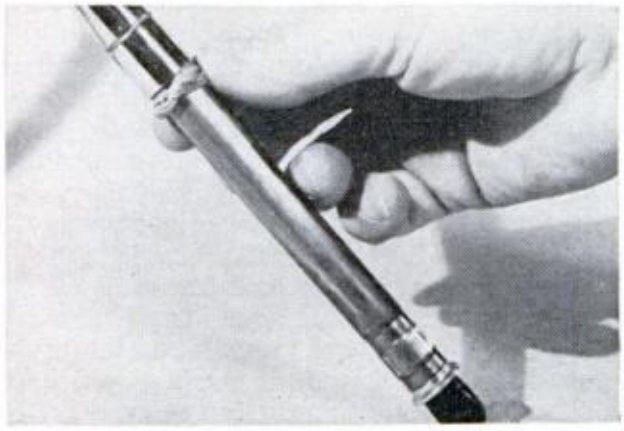


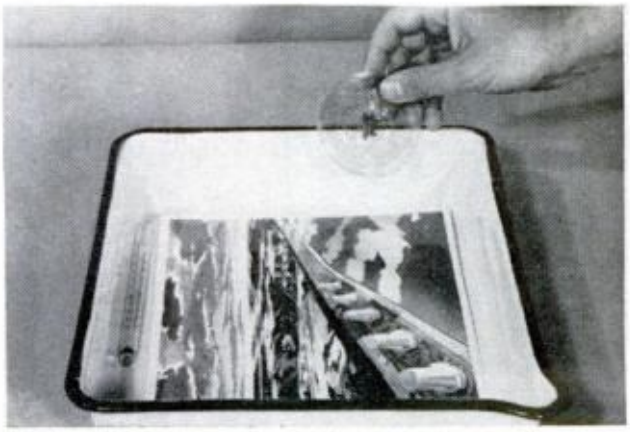
Accurate Exposure is assured when you use the Pentax Spotmatic 35–mm single-lens reflex camera. A through–the–lens metering system reads the exposure directly from the image focused on the ground glass. The camera with f:1.4 lens sells for $299.50. Honeywell Photographic Products, 4800 E. Dry Creek Rd., Denver, Colo. 80217.

Fully Automatic Camera using Kodapak cartridges has an AG-1 flashgun built into the side of the camera which automatically sets the correct exposure for either bounce or direct flash. Price of the Voigtlander Bessy AK camera with f:2.8 lens is $79.98. Carl Zeiss, Inc., 444 Fifth Ave., New York, N.Y. 10018.

THE LEGS of some tripods, especially the lightweight models, are made so that they can be extended only to certain lengths. An easy way to lock the leg at an intermediate position is to twist a rubber band around it to prevent the section from telescoping

A BABY'S TEETHING RING of the liquid-filled type is a useful darkroom accessory. If a developing solution gets too warm, freeze the ring and place it in the developer to cool the solution sufficiently. There is no risk of the developer becoming contaminated





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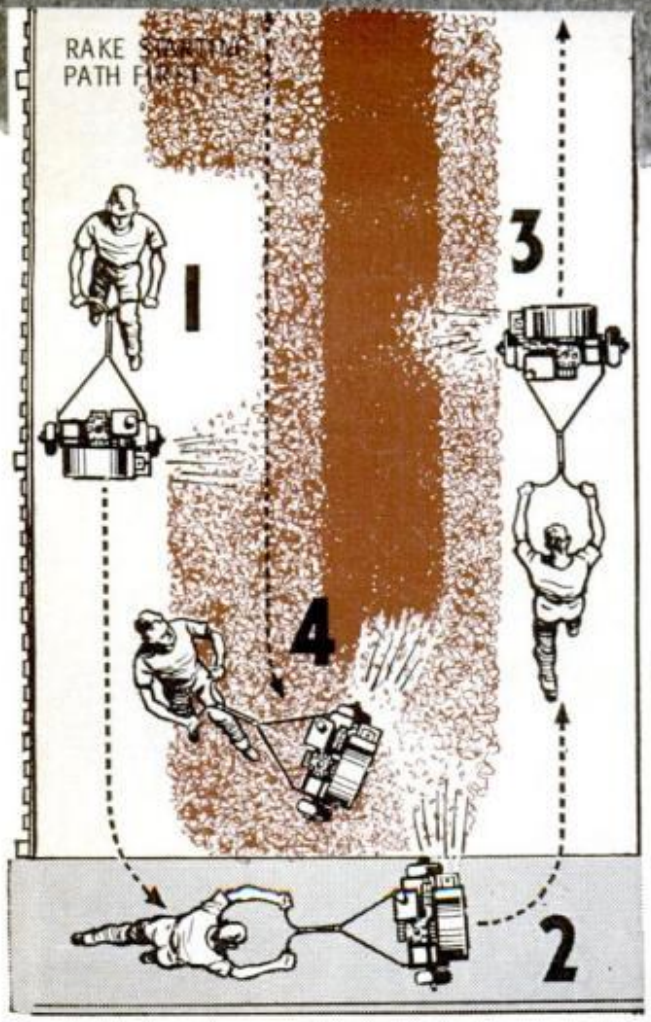
It Sure Beats Raking!

Your yard and patio will stay clean as a whistle this fall when you make yourself a leaf blower that whips up an 80-mph wind. You buy the parts that are hard to build

By Manly Banister



TIRED of being a rake slave? Next to having a giant vacuum sweeper, this tornado-on-wheels makes the job of raking your lawn the quickest yet. Pushed like a mower, it sends leaves scurrying into a central pile as you circle the lawn in a spiral pattern. It's three times as fast as picking them up with a lawn sweeper and can save as much as a day by hand if your lawn is of any size. Of course, you still have the job of lugging them off to be burned, but the time it takes to rake the pile onto a tarp is nothing. And "leafing" isn't the only job the blower will do. The 80-mph airstream it kicks up will scoot sticks and twigs right along with the leaves, and it's great, too, for gathering grass clippings after mowing, in case you want them for compost. Needless to say, a broom is no match for it when it comes to sweeping your drive and patio.

The machine consists of three main parts—the blower and housing assembly, a gasoline engine, and a carriage with a push handle. I bought my fan from a fac-

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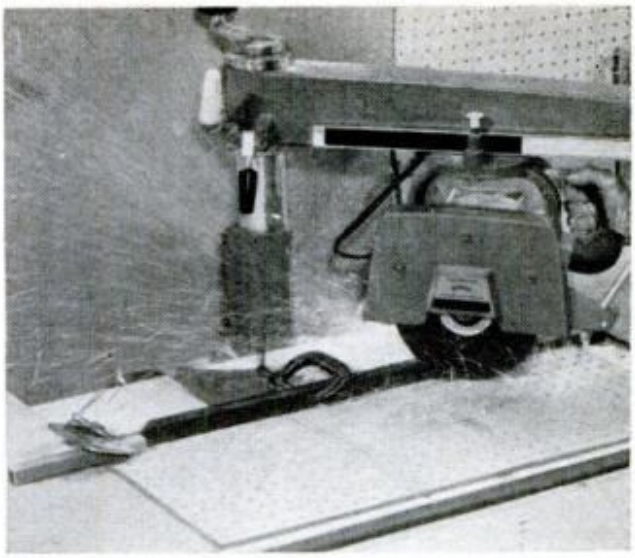
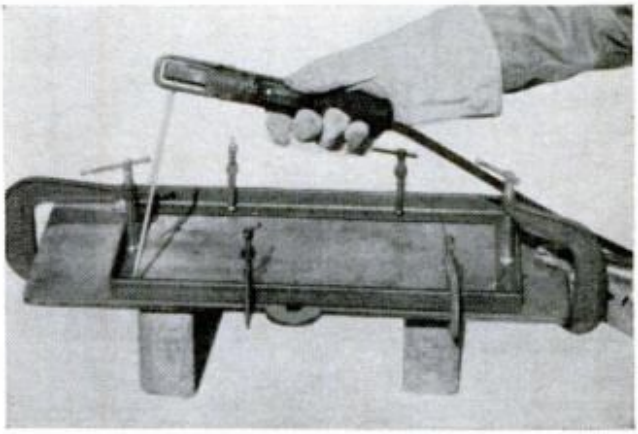
tory specializing in ventilating equipment; you can order an identical unit, complete with housing, through the W. J. Darm Co., 1313 S.E. 12th Ave., Portland, Ore., 97214, for $24.50 f.o.b. Portland (it'll be shipped express collect). This fan is designed to spin clockwise when viewed from the hub-side, so it'll rotate counter-clockwise when seen from the power-takeoff side of the engine, and that's the direction the engine-shaft turns. I find my 3-hp Briggs & Stratton just right for the job. Less horsepower might not rev the fan up enough, and too much could damage the blower blades. I bought the engine from a standard mail-order catalog for $44.

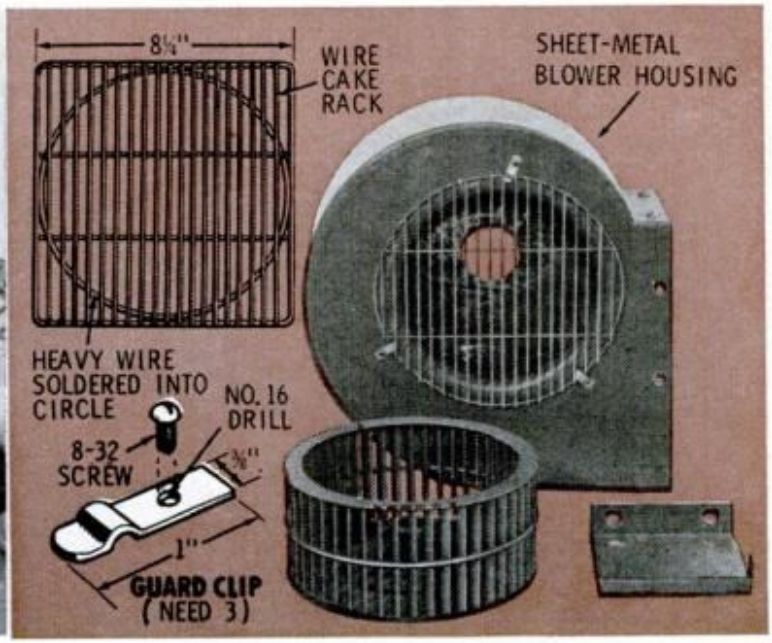


RADIAL ARM SAW simplifies accurate cutting of angle for carriage. Stop-block (left) assures equal-length pairs. Miter is cut in one pass by pushing aluminum-oxide blade slowly across to prevent stalling



SETUP FOR WELDING outside frame has pieces squared and clamped to steel plate (if no plate available, use plywood and ground to angle). Weld only inside, leave clamped till welds cool to prevent buckle

CUSTOM-MADE GRILLE for air intake is simple matter of silver-soldering wire ring to existing baking rack that's been trimmed to rough circle. Use blower wheel as form for bending ring. Brick keeps heated wires from lifting. When cool, cut wires flush with ring, grind ends smooth, attach to housing with three clips



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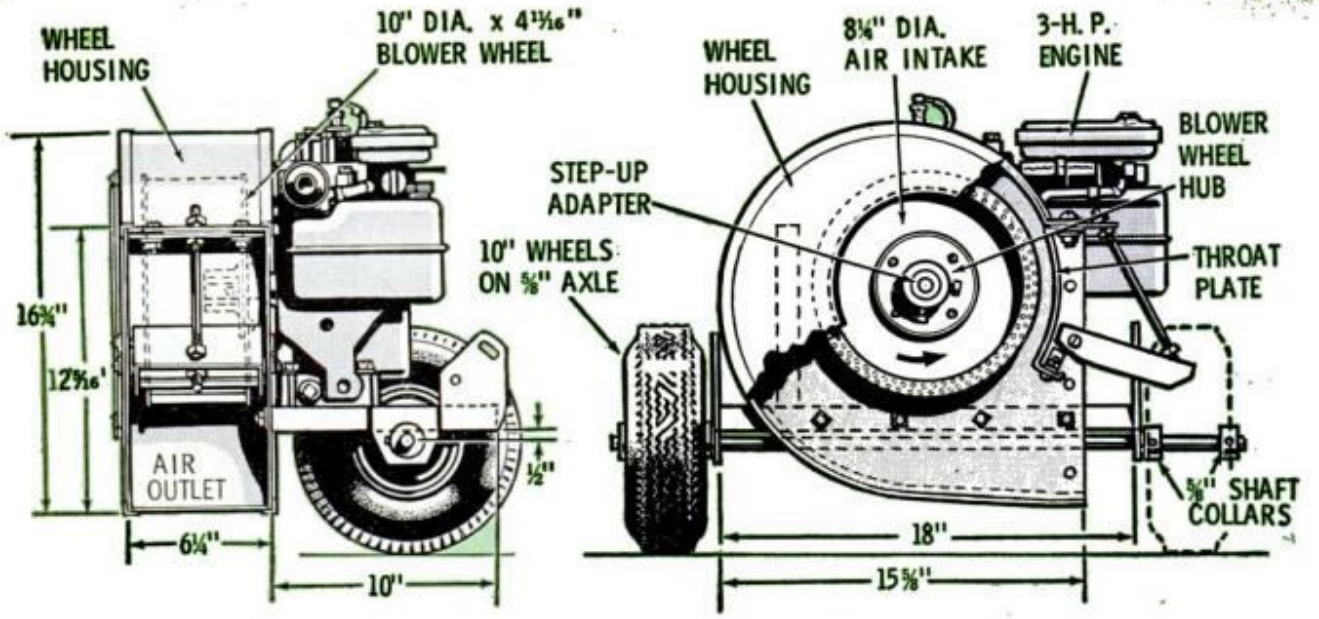
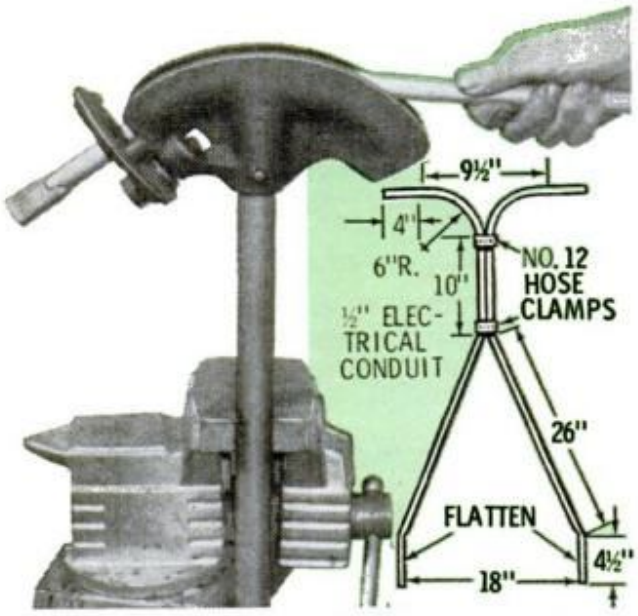
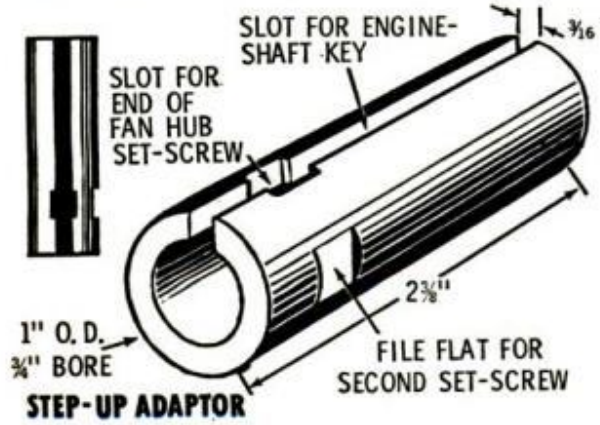


CUT, FOLD, TAPE **LEAF BLOWER**



SLOT ADAPTER with two passes into metal-cutting bandsaw; hold tube blank vertical in drillpress vise. Adapter mates ¾-in. engine shaft and 1-in. fan hub



STEP-UP ADAPTOR

Because of its short shaft, the engine must be set flush with the leading edge of the carriage, and smack against the blower housing. You must make an adapter to mate the ¾-in. shaft to the 1-in. bore of the fan hub, as shown in the detail. In assembling, be sure that one of the hub setscrews bears directly on the key in the engine shaft, and not on the adapter. You'll have to drill the slot wider to pass this setscrew; you can locate this accurately by trying the fan on the shaft with the setscrew removed so you can mark through its hole. The fan is correctly adjusted on the shaft when the adapter is slipped on as far as it will go and the outboard end of the fan hub is flush with the end of the adapter.

I made the push handle from a 10-ft. length of ½-in. conduit. After cutting it into two 5-ft. pieces, I hammered a wooden plug into one end of each length, filled both with dry sand, then plugged the open ends. At a point 4 in. from one end. I bent each length at right angles with the aid of a conduit bender. Next, using a carpenter's square and chalk, I drew on the shop floor the shape of the lower part of the handle. Then, carefully lining up the second bend with the first, I bent it as far as I thought necessary and compared the bend with the pattern drawn on the floor. Any overbending is easy to correct by simply reversing the work in the bender. Bend the second length to match.

I sawed off both tubes at a point 31 in. from the second bend, then flattened the final 4½ in., first by a series of squeezes in the vise, followed by hammering on a steel plate. The flattened ends were finally bent around into position by clamping them in the vise and applying leverage to

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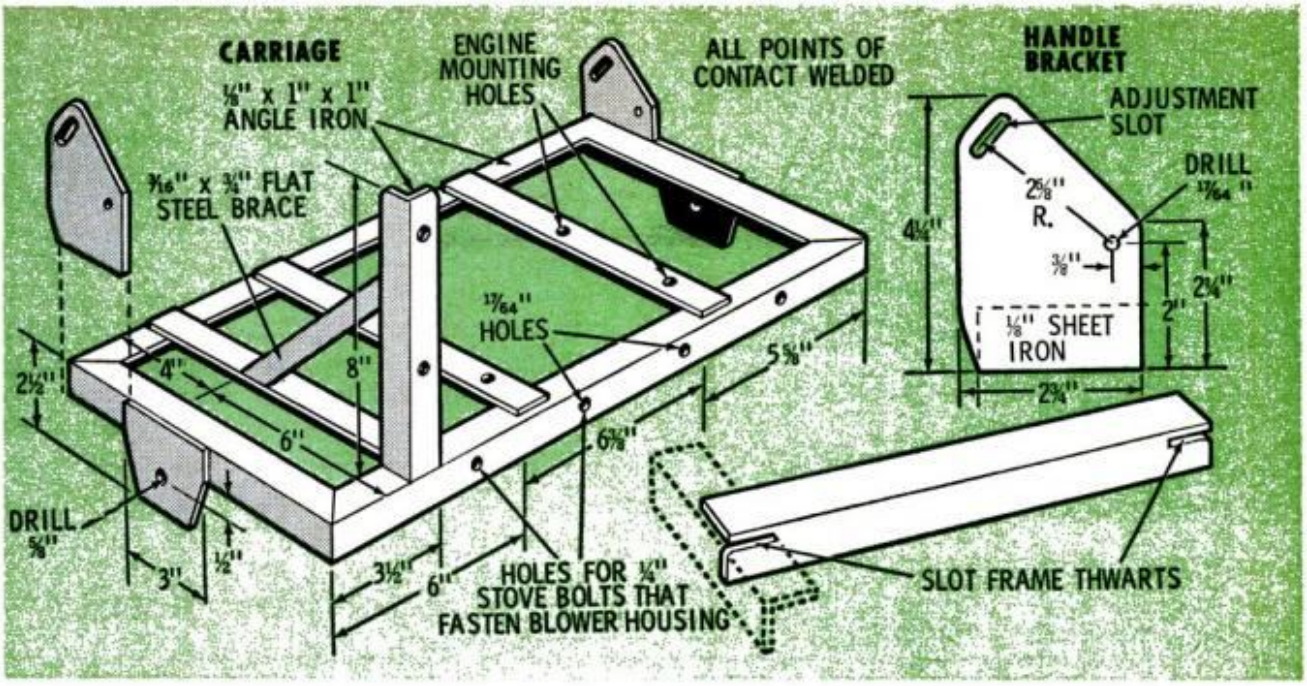


the remainder of the now-empty conduit.

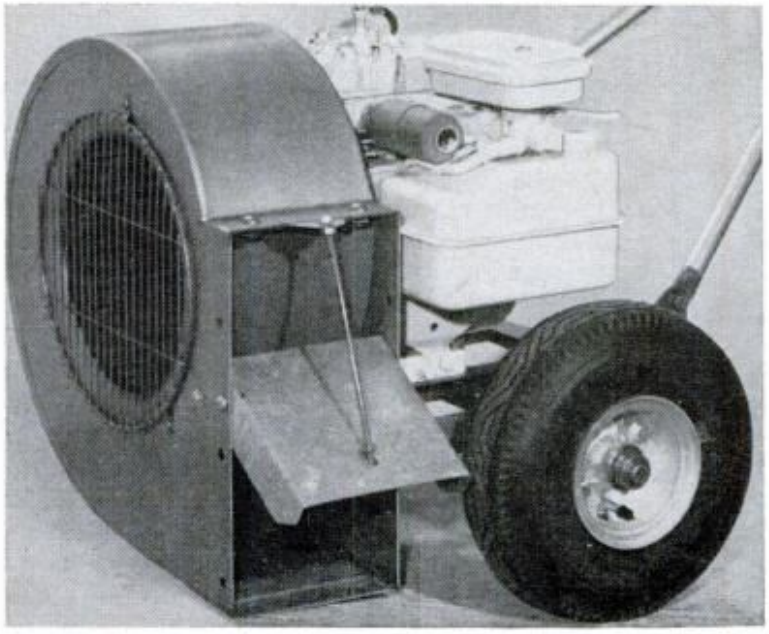
I joined the two tubes with stainless-steel hose clamps (the kind that work with a wormgear and screwdriver) by placing them flat on the floor. They were then marked and drilled for ¼-in. stud bolts for attaching to the carriage bosses.

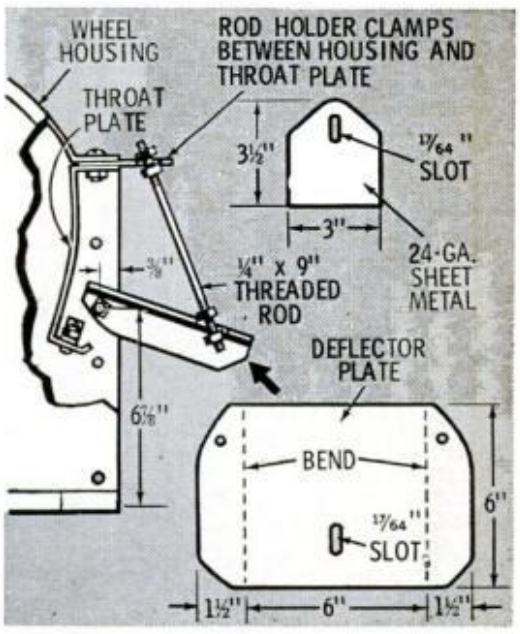
A safety grille for the fan blade is a must. The fan sucks air with terrific force and the grille keeps out foreign objects which might damage the fan, as well as hands, small dogs, etc.

The airstream deflector directs the gale parallel to the ground with little force being felt at ground level within several feet of the outlet. Everything beyond that point, however, can be felt in the next county. The main purpose of the deflector is to keep the force of the air within bounds. When directed downward, the airstream strikes the ground full force, close to the outlet and becomes fan shape like a bamboo rake. The main force of the airstream is thus kept within a distance of about 6 ft. so that it will blow the leaves into a pile but without blowing the pile itself into the neighbor's yard.

I used 10-in. pneumatic wheels for easy wheeling over rough ground and curbs. If you use smaller wheels, remember to change the height of the axle hanger so that the lower edge of the blower housing rides about 2 in. above the ground when the carriage is level. ★★★

AIRSTREAM DEFLECTOR is hung from retainer plate that's cut from same sheet metal and driven between housing and throat plate. Threaded adjusting rod has two nuts to clamp against slot at each end, permitting wide range of air-stream control. When adjustment is best for job at hand, nuts are turned up tight





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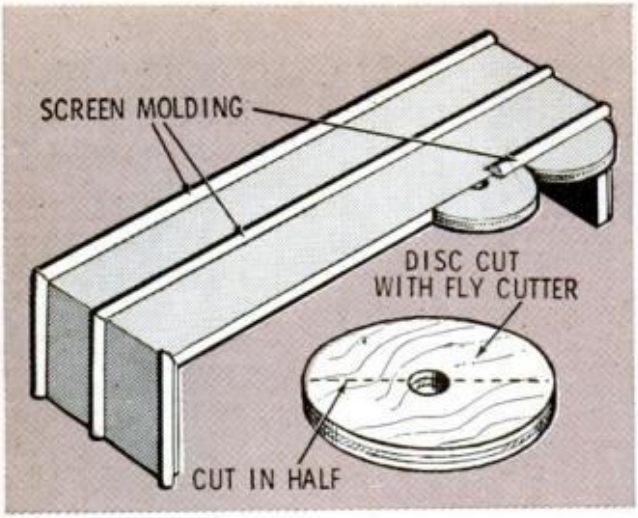
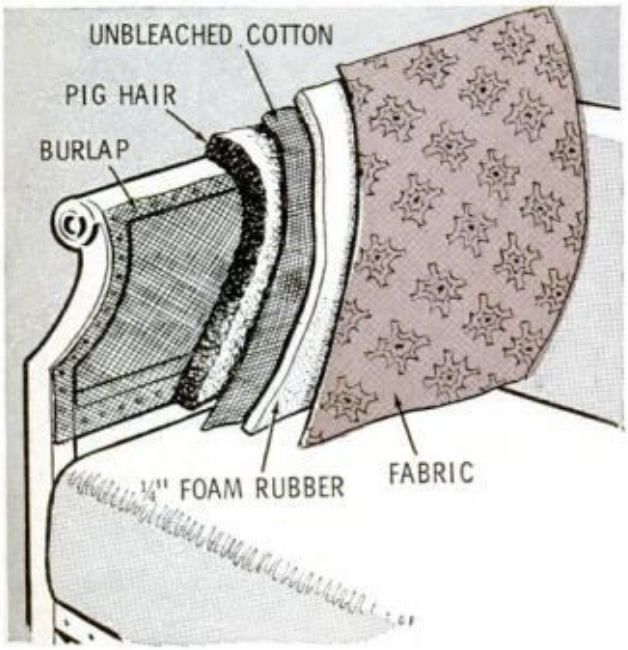


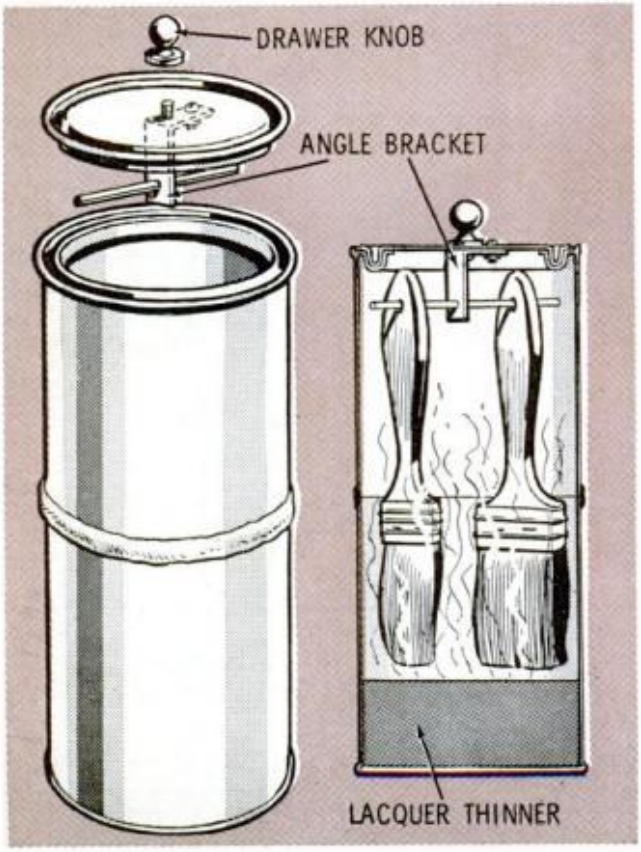
Scalloped Edge from Discs

When you want to form a scalloped edge and a bandsaw or saber saw isn't available, it's easy to make an add-on edge from discs cut with a hole saw or fly cutter. Simply cut the discs in half and glue these halves along the edge of the board. In most projects, such as the cornice shown here, the joint may be covered with a strip of molding. If this isn't feasible and the discs were cut with a fly cutter which leaves a hole in the center, saw on either side of the hole rather than through the center.—*S.N. Stresnic*



Shortcut Upholstery Material

Rubberized pig hair, an automotive upholstery material, can take the place of fiber, cotton or normal hair padding to make home upholstering jobs easier. It comes in sheets from 1½ to 2 in. thick and can be cut with tin snips, simplifying the problem of fitting arms, backs and seats. When used in conjunction with foam rubber sheeting, it duplicates the comfort of solid foam rubber at a lower cost. Rubberized pig hair is still used in the rear seats of passenger cars and also in truck cab cushions. It's available at many salvage outlets and retail stores specializing in upholstery supplies.—*A.J. Stephenson*



Solvent Vapor Cleans Brushes

An efficient brush keeper that also cleans brushes can be made from two one-gallon paint cans. Just cut the lip off the top of one can and remove the bottom from the other, then solder them together to form one tall can. Bolt an angle bracket to the underside of the lid and solder a length of stiff wire in the bottom hole to form a T-bar. To use it, pour one or two cups of lacquer thinner into the keeper, suspend dirty brushes from the T-bar above the thinner and seal the lid. Let it sit for a few days and you'll find that even the hardest brushes will soften. Clean brushes placed in this keeper can be taken out and used immediately, without wiping. (As proof of its efficiency, this system even removes the paint from the brush handles.)—*Keith Jameson*

Don't bother renting a wallpaper steamer for small jobs. Instead use your wife's steam iron as you would a commercial steamer and the wallpaper will peel away from the plaster easily.

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Sliding-Top Cocktail Table

Traditional maple styling with a practical modern twist. Divided tile top doubles as serving trays when pulled out. Center well nests bottles and ice, preventing spills

By Steve Ellingson

TRULY A COCKTAIL TABLE in every sense of the word, this one converts quickly as a lazy help-yourself "bar" to make informal entertaining about as convenient and carefree as can be. Slide open its divided top and there's a center well for holding everything you need to wet a whistle. The tile-covered tops serve as serving trays (or counters) which drinks can't harm, and when the party's over, it all goes back to being a self-repecting combination coffee table and magazine rack.

Ready-turned legs and their mounting plates (buy them any-

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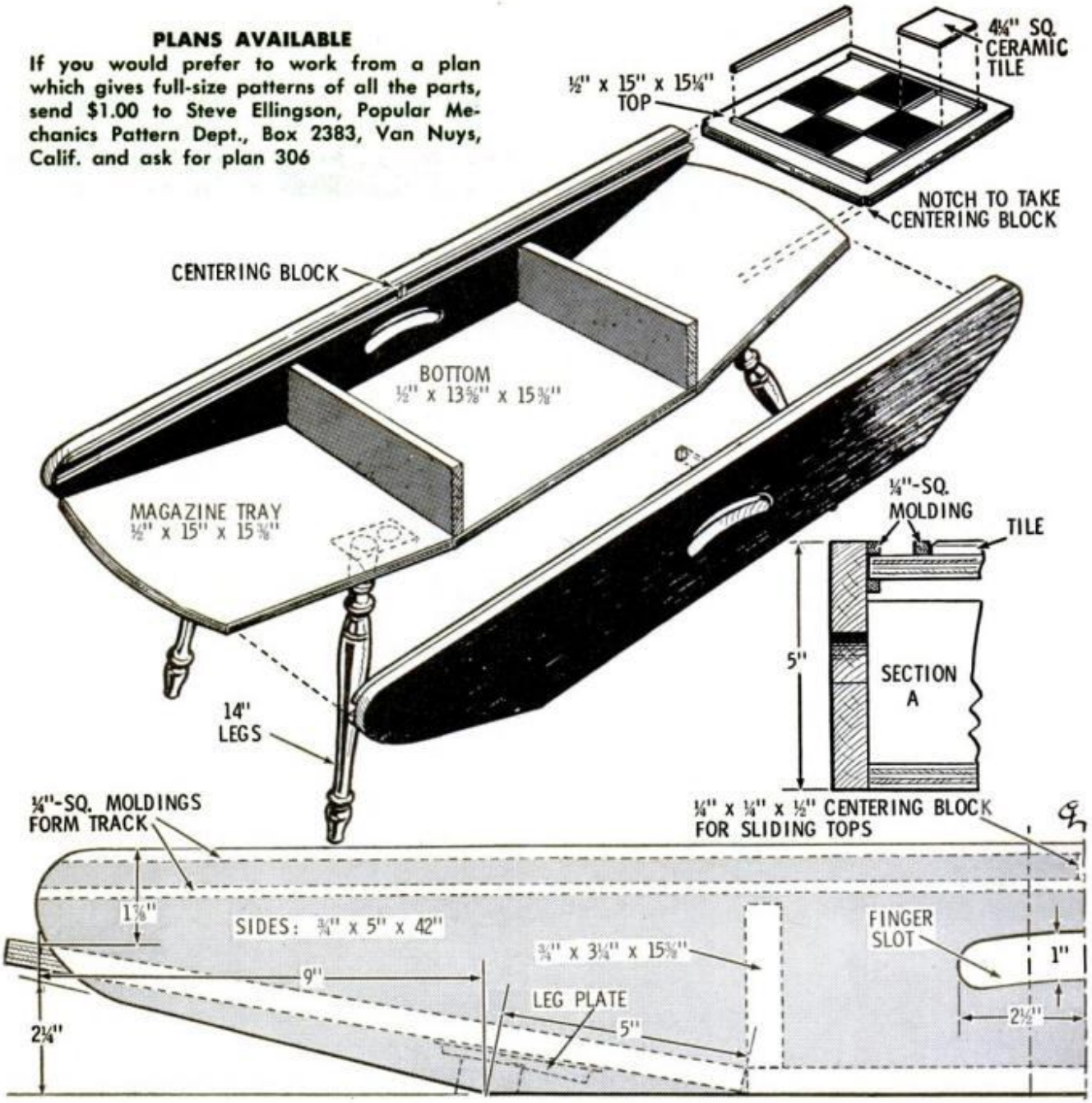
PLANS AVAILABLE

If you would prefer to work from a plan which gives full-size patterns of all the parts, send $1.00 to Steve Ellingson, Popular Mechanics Pattern Dept., Box 2383, Van Nuys, Calif. and ask for plan 306



where, reduced construction to little more than a hammer-and-saw project. The only part that's not made in duplicate is the bottom; you make two of everything else. You'll do best to cut the two sled-runner sides both at one time so that they will be identical. By cutting the hand slots last, you can hold the two boards together with a couple of nails driven through at this point. If you have to use a handsaw to round the ends, make a series of cuts tangent to the line and then work down the rest with a plane and sandpaper block. When you're ready to cut the hand slots, bore 1-in. holes at the ends and saw out the waste between with a keyhole saw. Tracks for the sliding top sections are formed by gluing and nailing ¼-in.-sq. strips to the inside and spacing them a scant more than the top's thickness.

The two sled-runner sides (of solid stock) are joined by two ¾-in. dividers, 15⅜ in. long. These are placed ½ in. up from the lower edge to accommodate the plywood bottom of the well and are glued and nailed to the sides from the outside. The exposed nailheads are later sunk and puttied. The bottom fits between the sides and laps the edges of the dividers. The plywood pieces which form the magazine trays fit between the side members only, to which they are also glued and nailed from the outside. The curved ends of the trays have about a 24-in. radius.

The tops of the two sliding sections are tiled with regular 4¼-in.-sq. ceramic tile, nine being required to cover each ½-in. plywood panel. A space of 1/16 in. is left between each tile and between the outside tile and the ¼-in.-sq. strips which fence them in. Apply mastic to the backs of the tile and set them in place. When dry, mix grouting powder into a paste and fill level all joints between the tile. Wipe off the excess and, when dry, clean the surfaces of the tile with a damp cloth. ★★★

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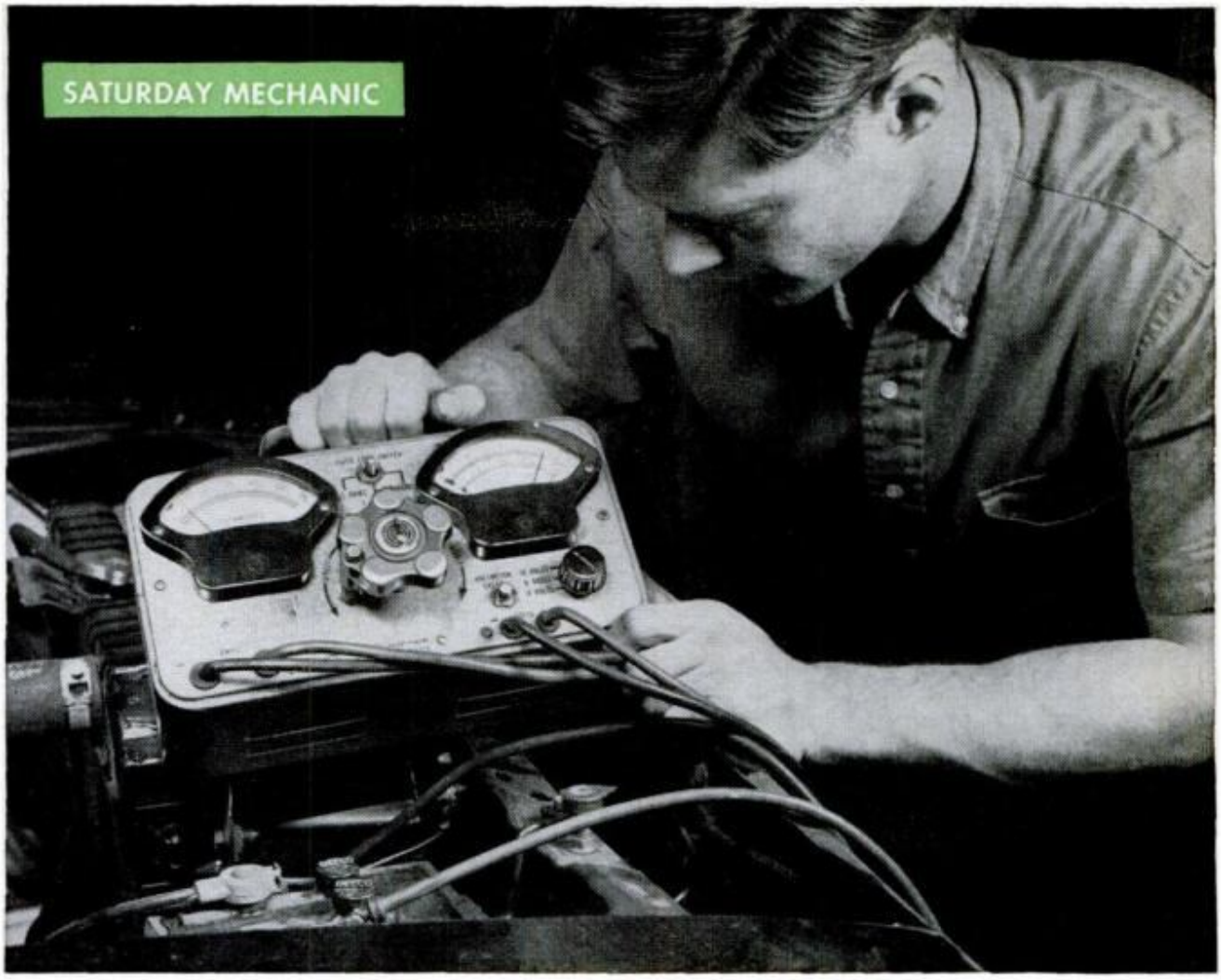

Checking Out Your Circuits

By Morton J. Schultz

"LOOK, YOUNG FELLA, I been workin' on cars for 20 years and never did need any of those fancy gadgets." The mechanic bounced a stream of tobacco juice off my old battery, lying in the junk heap.

His contemptuous retort was in answer to my guarded question as to how he knew the battery was bad without some sort of battery tester.

I let it go, not wanting to antagonize the guy. We'd stopped the night before at a motel in the boondocks and this morning the car wouldn't start. Still had some 800 miles to go before our Miami vacation, so I had to trust him.

Next morning, and $16.95 poorer, I was in the same no-start fix again. Luckily, we had reached Daytona Beach and had the car towed to a dealer where a meter was hooked into the circuit. The trouble was not the battery, but the cables.

This incident brings out two irrefutable facts about automotive electricity:

- There are no shortcuts to electrical testing. You *do* need "fancy gadgets," as well as a clearly defined and orderly testing procedure.
- Automotive electricity remains a riddle wrapped in a mystery inside an enigma for many, including many good professional mechanics. Why this should be is anyone's guess. The subject just isn't that difficult to understand.

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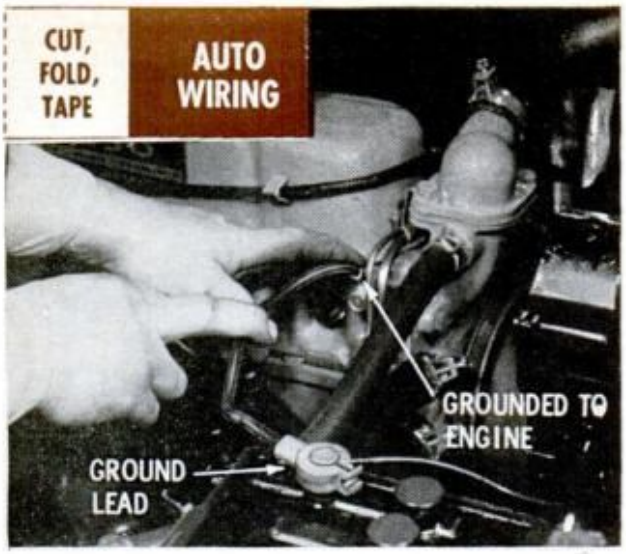
CUT, FOLD, TAPE

AUTO WIRING



BATTERY GROUND CABLE is usually connected to engine. Before testing, check connection to make sure that it is tight and completely free of corrosion

The wise car buff doesn't wait for trouble to strike before testing his vehicle's electrical system. To me, this system needs periodic attention just as much as tires, carburetor, chassis or anything else.

An electrical component seldom fails completely all at once. Usually, it weakens gradually. Modern test equipment can pinpoint the weakness and allows you to make repairs before you find yourself in a fix. For that reason I give my electrical system a thorough test-out every 12,000 or so miles.

The electrical system is divided into three main circuits: starting, charging and ignition. The latter was discussed in a recent two-part *Saturday Mechanic* article (*Controlling Your Car's Control Center*, page 158, Dec. '64 *PM*) so we won't concern ourselves with it here.

The starting circuit—the place to begin testing—consists of the battery and starter. Obviously, they start the car. Once it's started, though, these parts are no longer needed since the job of providing electricity is taken over by the charging circuit which consists of the generator or alternator and regulator. We'll get to these next month. All circuits, of course, have wires and cables that hook parts together. They can't be overlooked.

It's commonly, but erroneously, believed that the battery stores electricity. Actually, however, the battery converts electricity it gets from the generator or alternator into chemical energy and stores *that* until needed. Then, when the battery and starter are connected electrically, by the simple action of turning on the ignition key, the battery's chemical energy is transformed back into electrical energy, and current flows from battery to starter to ground, and back to battery—something like Tinker to Evers to Chance.

With most starters, electricity coming from the battery first activates a powerful little device called the starter solenoid, which does two jobs simultaneously: (1) closes a switch which allows the full flow of current from the battery to enter the starter motor itself, and (2) energizes a plunger-type gadget that pushes forward and drives a pinion gear into mesh with the flywheel. That gear is on the aft end of the armature shaft of the starter motor.

With the pinion gear and flywheel mated, the flow of electricity in the starter motor revolves the armature at great speed. The armature drives the pinion gear, which drives the flywheel. And . . . the engine starts.

When the engine begins to chug and you release pressure on the ignition switch, you break the electrical connection between battery and starter. With the "pressure" off, a return spring inside the solenoid pulls the plunger back, releasing the pinion gear from the flywheel. Otherwise you'd have one chewed-up gear, a chewed-up flywheel, or both. At this point, the starter has nothing to do until the next time you start the car.

Now for the testing. First, though, let's not kid ourselves about one thing. If you're serious about doing your own automotive electrical work, you need the right test equipment. Without it, you can only guess what's wrong with the electrical system—and that's both inaccurate and expensive.

The two basic testers you need are a voltmeter and ammeter. The voltmeter checks electrical "pressure" (volts) while the ammeter checks current flow (amps.).

To simplify things, think of an auto electrical circuit as water flowing from a pump into, through and out of a pipe. The pump (which we can liken to the battery) exerts a force which is usually expressed in pounds per square inch (p.s.i.) against the water inside the pipe to obtain a desired rate of flow. The rate of flow is usually expressed in cubic feet per minute (c.f.m.). In electrical systems, the "pressure" or p.s.i. becomes *volts*, while the rate of flow or c.f.m. becomes *amperes*. The "pipe," of course, is the wiring.

The battery-starter tester we show in this article is actually a combination unit containing a voltmeter and ammeter, plus a built-in carbon pile (shunt) that allows controlled variation of the current passing through the meters. It permits quick, accurate tests of battery, starter, and cables under operating conditions.

I'm not kidding when I say that automotive electrical testing requires a unit similar to the one shown. It need not

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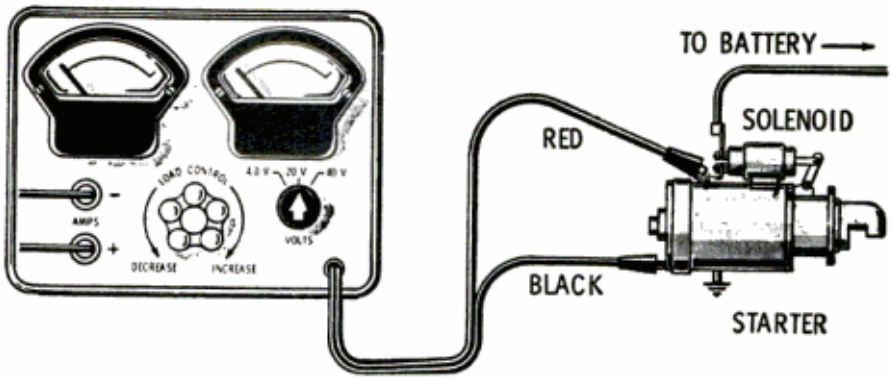
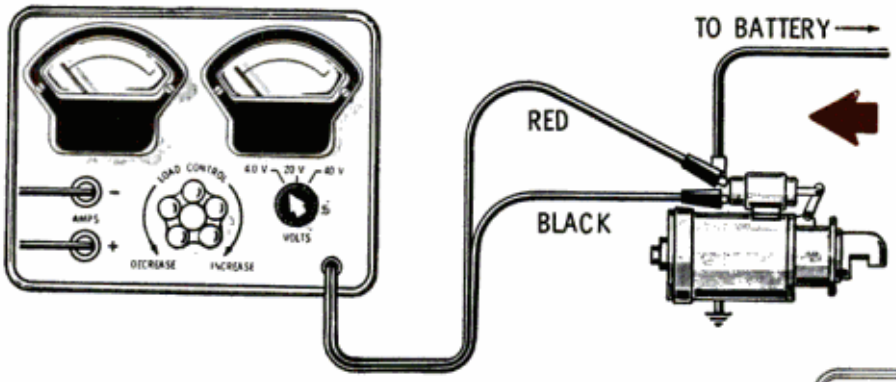
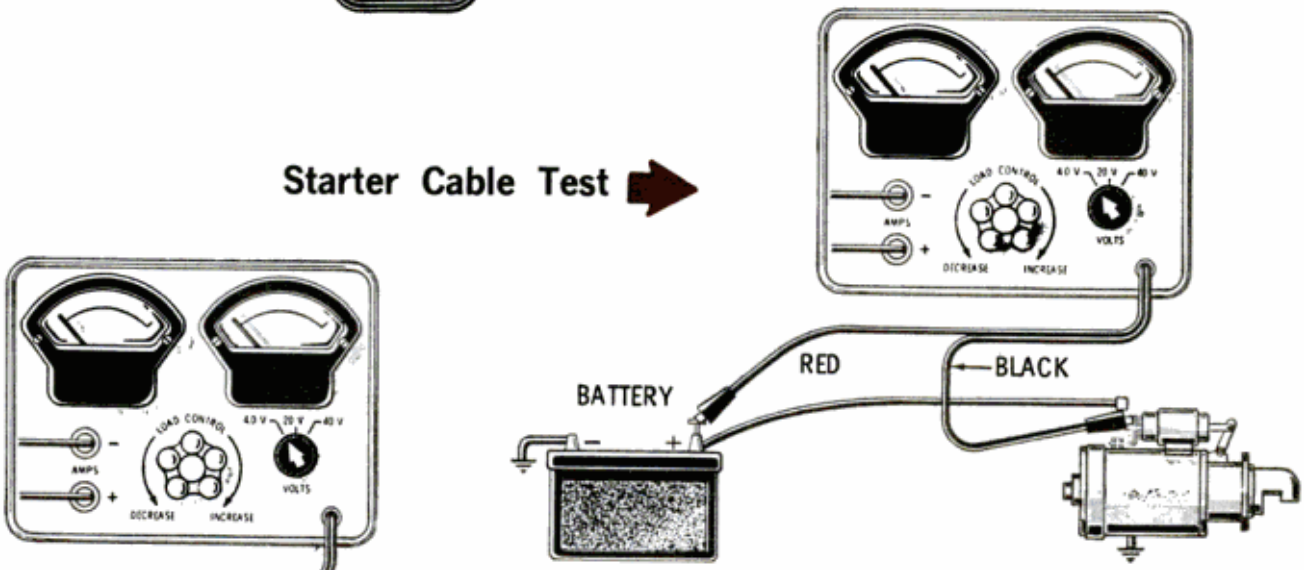
Starter Cranking Voltage Test



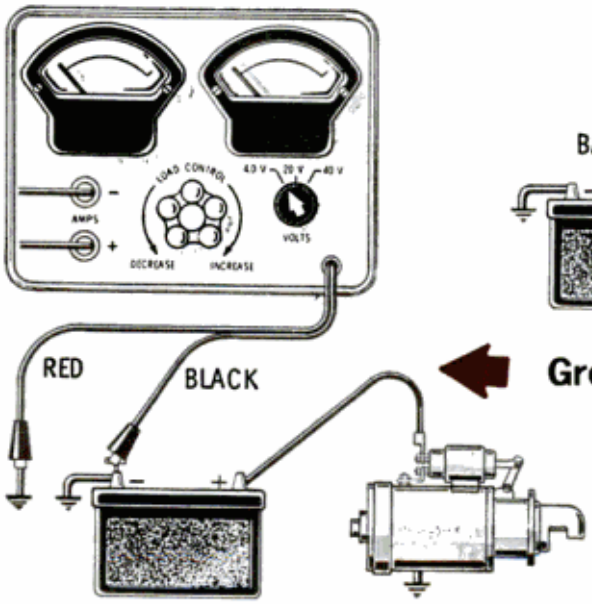
Starter Solenoid Test



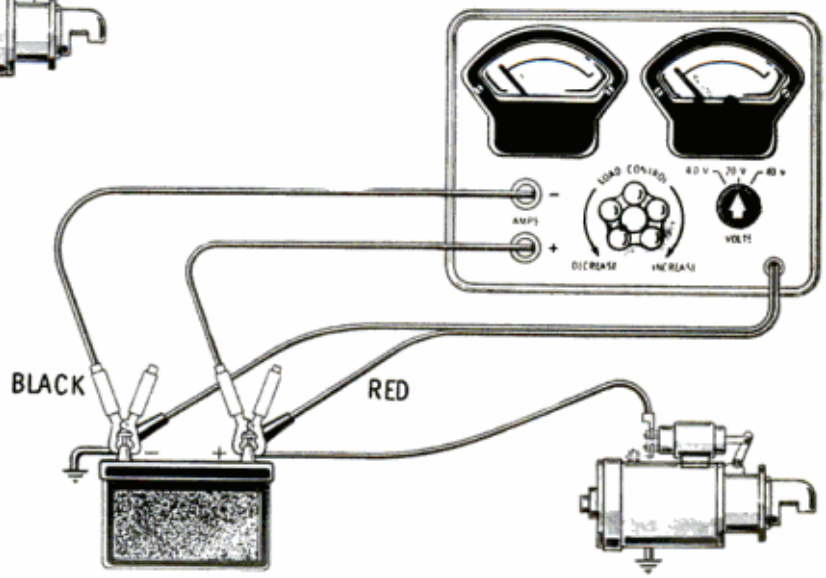
Starter Cable Test



Ground Cable Test



Starter Draw and Battery Capacity Tests



Note: In all tests, reverse lead connections for positive ground systems.

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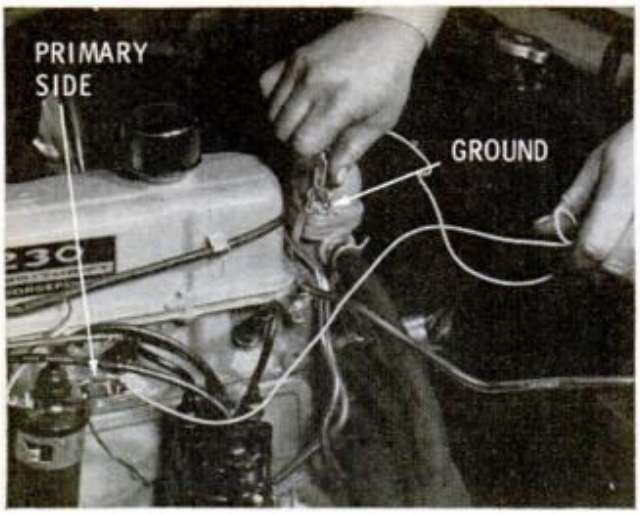

TO CRANK YOUR ENGINE without starting it, connect a jumper wire from the primary side of the coil or distributor to ground. This way, current goes directly to ground without ever reaching sparkplugs

come in compact form, such as ours. It could be a separate voltmeter and ammeter, with an external carbon pile. Whatever the makeup, resign yourself to the fact that it'll cost in the neighborhood of $50. But it's worth every cent.

If you decide to buy a tester, read the instruction manual carefully. Although all testers work basically the same way, and all hookups for auto testing are the same, there are different features from one meter to another, such as scales and the ways to read them. However, the black leads are always negative and the red (or other color) leads positive.

Most cars today, except some foreign jobs, are negative-grounded, so the black leads of the tester will always be connected to ground. However, if your car is positive-grounded, as in many older-model Chrysler products, the red lead becomes the ground lead.

If your car has a generator and you accidentally hook up test leads the wrong way, no harm's done. When you spot the error, simply reverse the leads. If it has an alternator, the wrong hookup could cause irreparable damage since there's a direct connection between the battery and alternator output terminal at all times.

Reversing test leads, even for a second, can short out the alternator output terminal and send full battery voltage back into the alternator, burning up diodes and wiring. For this reason, you must make very sure your hookups are correct the first time.

So much for the background material. Now let's get into the tests themselves.

• *Battery Capacity Test.* This tells you whether the battery has sufficient pep for starting. Here's how it's done:

Make sure the shunt control knob is off and connect the leads of both the ammeter and voltmeter (diagram, page 179). Turn the shunt control knob toward the "increase" direction until the ammeter reads three times the ampere hour rating of the battery. This rating is usually inscribed on the battery case.

For example, suppose you have a 12-volt battery rated at 50 amp. hours. Increase the shunt control until the ammeter reads 150 amps. (3 times 50). When this point is reached, wait 15 seconds and read the voltmeter scale. You should get a reading of 4.5 v. or above for a 6-v. battery and one of 9.0 v. or above for a 12-v. battery.

Any battery that meets this test is a good one. If you don't get the required reading, don't bother testing the starter; you'll only get inaccurate results. Get another battery you know is in good shape or recharge the old battery and then do the capacity test again. If still not up to snuff, you need a new battery.

• *Starter Cranking Voltage Test.* This tells you the overall condition of the starting circuit. If the circuit flunks this test, others are needed to find exactly what's wrong.

Hook up the meter as shown on page 179. Connect a jumper lead from the distributor primary terminal to ground on the engine. This grounds out the primary circuit and prevents the engine from starting as you crank it.

Crank the engine and read the voltmeter. (Incidentally, make sure you don't crank for more than 15 seconds for any of these tests. They put a terrific strain on the battery and starter.)

If the starting circuit's in good shape,

CLEAN POSTS AND TERMINALS before testing. Aside from preventing accurate readings, dirt and corrosion can prevent car from starting. Battery cleaning tool shown here costs about $1 in auto supply store

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you should get a voltage reading of 5 or more for a 6-v. system and 10 or more for a 12-v. system. If you get these figures, and the battery capacity checked out, everything in the starting circuit is okay. If not, then you have to zero in on the problem area by testing the solenoid, all cables and the starter itself. Here's how to do this, again using the meter hookups shown on page 179.

• *Starter Solenoid Test.* When hooking up the meter, be sure to keep the jumper wire going from the distributor primary to ground in place. The voltmeter selector scale should be set in mid-range. On the meter in the sketch this is the 20-v. scale. Yours should be about the same.

Crank the engine and read the voltmeter. Turn the voltmeter selector switch to the lowest scale—on the meter in the sketch, that's the 4.0-v. scale. Note the reading and immediately switch back to mid-range before you stop cranking.

What you're looking for is a so-called voltage drop—the difference between what you get on the mid-range scale and on the low-range scale. If that is more than 0.1 v. in a 6-v. system or above 0.2 v. in a 12-v. system, the resistance of the starter solenoid is high. Replace the solenoid. This same test, by the way, can be made with an ohmmeter, if you have one and prefer to use it.

• *Starter Cable Test.* After hooking up, switch the voltmeter selector switch to mid-range. Crank the engine and read the voltmeter. Switch to low-range, read the meter and switch back at once to mid-range, as before.

Again, a meter reading of above 0.1 v. for a 6-v. system or above 0.2 v. for a 12-v. system indicates high resistance. This defect is usually caused by a bad cable or dirt or corrosion on battery post or starter cable terminal. Remove the cable, clean off the post and terminal, reinstall the cable and test again. If the reading isn't better, replace the cable. By the way, make sure all connections are tight. Loose ones can also cause high resistance.

• *Ground Cable Test.* Procedure for this is the same as for the Starter Cable Test, but the hookup is different. Just be sure you follow the right diagram.

Caution: In doing all these voltage-drop tests, the reading you get when the voltmeter selector is in mid-range must be *below* the highest point on the low-range scale. If it isn't, do *not* switch to the latter scale, or you'll damage the meter.

For example, with the meter shown in the diagram, suppose you get a reading of 5.0 v. on the 20-v. scale. The low-range scale will only measure from 0 to 4.0 v.

(Please turn to page 222)

Auto Upkeep Tips

• **WHEN INSTALLING** distributor points, make certain to set them on the high side of the shop manual specifications. This will compensate for wear on the rubbing block while the block is seating itself on the cam. As the block seats, point opening may become insufficient if initially set to the minimum.

• **ONE FREQUENT CAUSE** of engine stalling is a failure of the flex hose that runs between fuel pump and gas tank line. The inner liner of the hose may collapse and cut off the fuel flow, or tiny cracks may develop which permit air to get into the line causing vapor lock and possible stoppage of the fuel pump.

• **CARBON-FOULED** spark plugs may indicate that the carburetor air cleaner is clogged. This prevents sufficient air from reaching the combustion chamber. As a result, the gasoline is not completely burned and fuel cost is higher than it need be because the engine is receiving a mixture much richer than it actually needs for maximum power.

• **WHEN YOU TUNE** your engine, take a careful look at the distributor points. They are an accurate indication of condenser capacity. If the stationary contact is pitted, capacity is too high. Pitting in the movable contact indicates that the condenser capacity is too low and that replacement is needed.

• **IF ACCUMULATED RUST** and sediment have clogged the overflow pipe of your car's radiator, here's an easy remedy. Simply chuck a 2-ft. length of old speedometer cable in an electric drill. Insert the cable in the tube, switch on the drill and work the cable back and forth to clean out the obstruction.

• **MAKE SURE** your car horn won't embarrass you by accidentally blowing when shorted or grounded. Remove its wire from the relay and attach to the binding post a jumper wire terminating in an alligator clip, which will hold the horn wire. If electrical trouble makes the horn blow, just pull the wire from clip.

• **DOES YOUR AMMETER** indicate an abnormally high rate of charge? It could be that the battery is being kept in a state of discharge by dirt on top of the casing. The dirt may allow voltage to leak away to ground. To guard against this, it's wise to make battery cleanup a regular part of car maintenance.

Материал, защищенный авторским правом

Auto Clinic

Mort Schultz's remedies for mechanical headaches

Race Away

To race or not to race? That is the question for my '62 Olds "98" with air-conditioning. With it operating, the car stalls when idling if I have the carburetor tuned down to what I think's a normal idle. If I have it pepped up so the engine won't stall, the motor races when the airconditioner has been turned off.—Erwin R. Good, Miami

Whether 'tis better to suffer the revving of racing or the distress of stalling is a decision only you can make.

A car with an airconditioner has to be set at a higher rpm than one without. An Olds "98," for example, without air-conditioning is speced to idle at 500 rpms. Put a "cooler" in it and leave the idle at 500 rpm, and you've got a prime stalling vehicle when you turn the air-conditioner on. The unit draws off as much as 200 rpms, and the car just can't run at this low speed, so it stalls.

Compensation's made by increasing idle speed to 700 rpm—500 for the engine and 200 for the airconditioner. Naturally, with conditioner turned off, the engine takes the full 700 and races.

In northern states, those with air conditioning can reset the idle from winter to summer. In warm climates, though, where you never know from one day to the next whether you'll need airconditioning, I'd say set the engine at the higher rpm and leave it be. *M.S.*

Shushing a Timing Chain

The timing chain of my '61 Ford Fairlane started raising hell at 13,000 miles. Too much slack! We put in a new chain, and everything was as quiet as church on Monday morning for 6,000 miles. This time the chain busted. In went a new one. It's now 4,000 miles later, and I've got it again. How do I get rid of this headache?—Dick Long, Wilkes-Barre, Pa.

Get a headache powder from your Ford dealer in the form of a damper (C2ZA-6284A) which keeps the chain from slapping against the cover. Newer models have it factory-installed. *M.S.*

Covering the Anglia's Angles

Do you have any dope as to why the English Ford Anglia's such a tough one to start after a while? Mine's a '63. Other owners I know have the same complaint.—Bruce Stout, Quebec

Let's say the car's tuned. So what else? Valve adjustment's one possibility, since it's awfully critical and has to be on the nose. Another likely cause is ignition wiring that's broken down and not passing current. Original wiring on this car is carbon insulated. A friend of mine, who had your exact same problem, replaced this wiring with the neoprene-covered type. His Anglia's now an angel. *M.S.*

Money Grabber

Since it was new, my '63 Rambler Ambassador's been using two quarts of oil every 350 miles. No one can find out why. I like the car and want to keep it, if I can de-lubricate those dollar bills. Any thoughts?—Stan Davies, Union, N. J.

We've been told that some early model '63 Ramblers inadvertently left the factory without valve guide seals in them. Oil escapes around the valves. Need I say more? *M.S.*

EDITOR'S NOTE: When we began Auto Clinic we had no idea how popular it would be with our readers. Little did we think we'd be so swamped with letters that we'd have to set up a special system with additional help to handle the answers. But that's what has happened. Much as we would like to continue the clinic as a free service to our readers, we find we reluctantly must make a nominal charge to help cover the cost of diagnosing and handling your car problem—if we are to continue to answer all inquiries personally. Write Auto Clinic, Popular Mechanics Magazine, 575 Lexington Ave., New York, N.Y. 10022, enclosing a self-addressed envelope and 25 cents in coin.

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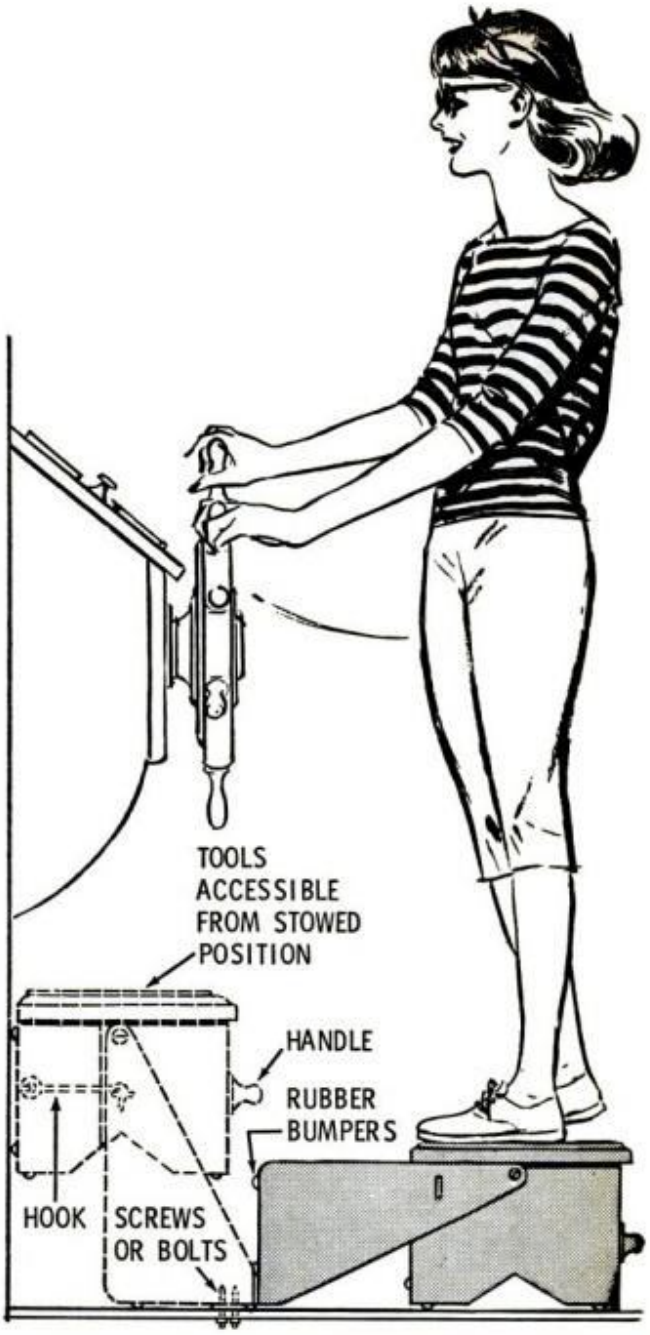
Helmsman's Step-Toolbox

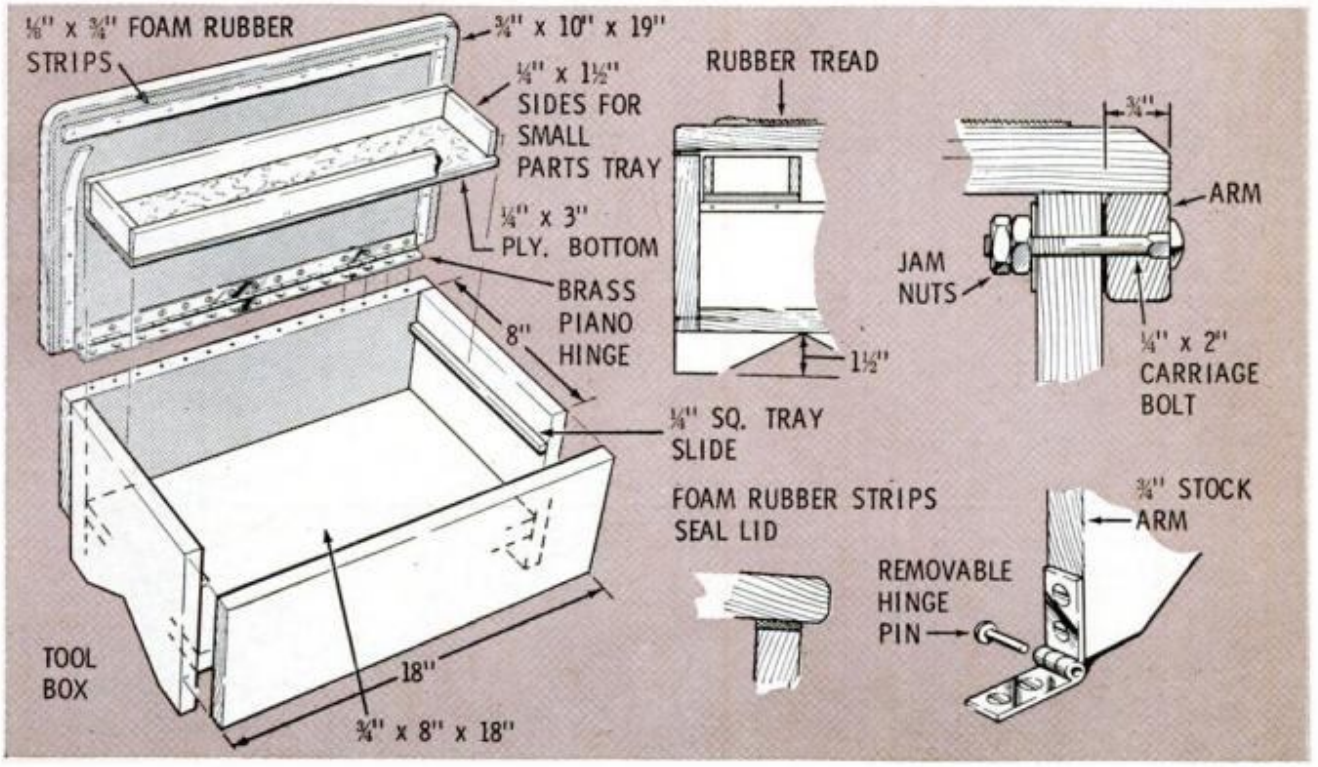
GOOD SAILORS start young, so when my daughter became old enough to take a short trick at the wheel of our outboard cruiser, I was all for it. There was just one problem—she was too short.

This simple box-step proved to be the perfect solution. Hinged to the deck, it swings up and locks against the bulkhead when not needed. Pull it down and it becomes a stable platform elevated 8 in. above the deck. Spare parts and tools are stowed away neatly inside.

Construction of the box itself is simple. Butt joints are used throughout, secured with both glue and nails. Narrow strips of foam-rubber (weatherstripping is fine) tacked to the underside of the lid form a gasket to seal the box against spray or rain. To provide a cushioning effect, ten rubber bumpers are required—four on the rear of the box, four on the legs and two on the support arms.

Materials and finish will depend on your pocketbook and personal taste. If your boat has mahogany trim, then that's the logical material for the box. Give it a couple of coats of urethane or spar varnish. Finally, mount a rubber stair tread on top with waterproof glue.—*Hank Clark*





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Do-them-in-your-head
Navigation Tricks

Try these cockpit tricks to impress less salty guests on your next cruise. It's all a matter of simple math, but you'll come on like gangbusters

By W. S. Kals

WHERE will a small course change take you? Obviously you'll miss your destination, but by how much?

Using the formula explained in the diagram below, you can figure the answer in a couple of seconds. It's easy to remember and has a number of practical applications.

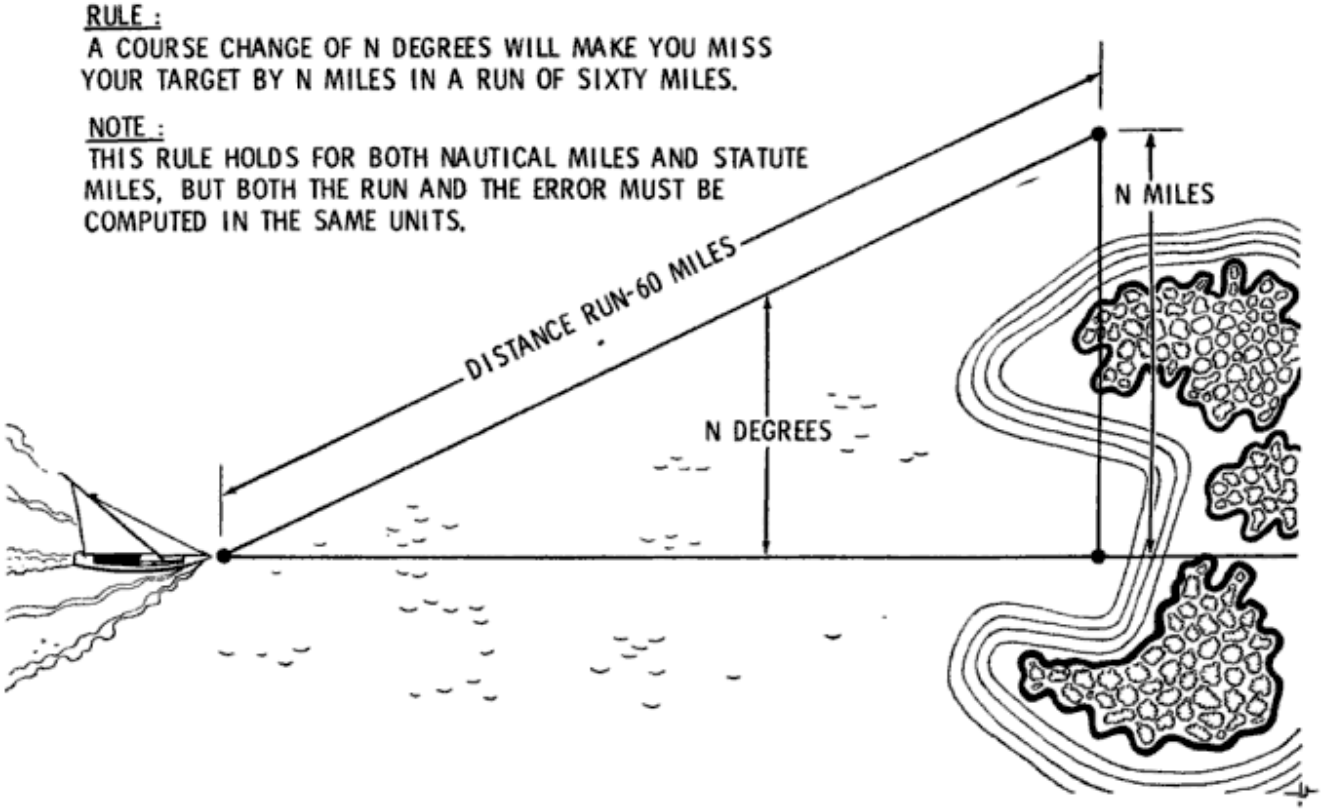
For instance, imagine you're headed for a small low island 20 miles away that's visible only when you come within three miles of it. You can't trust your compass and your helmsman to keep closer than five degrees of the direct course. Will you have any trouble spotting the island?

Five degrees error will set you off five miles in a run of 60 miles, a third of that distance in 20 miles. So you should come within about a mile and a half of your destination, leaving a margin of safety.

If calculation shows little or no margin of safety, you can use another sailor's trick: Set a course clearly to one side of your target, say three miles north of it. When you've run your distance, you'll see your island even if you've made a southerly error. If you don't see it, turn due south since you should be directly north of your destination.

This formula for off-course calculations works well up to 20 degrees.

What price error?



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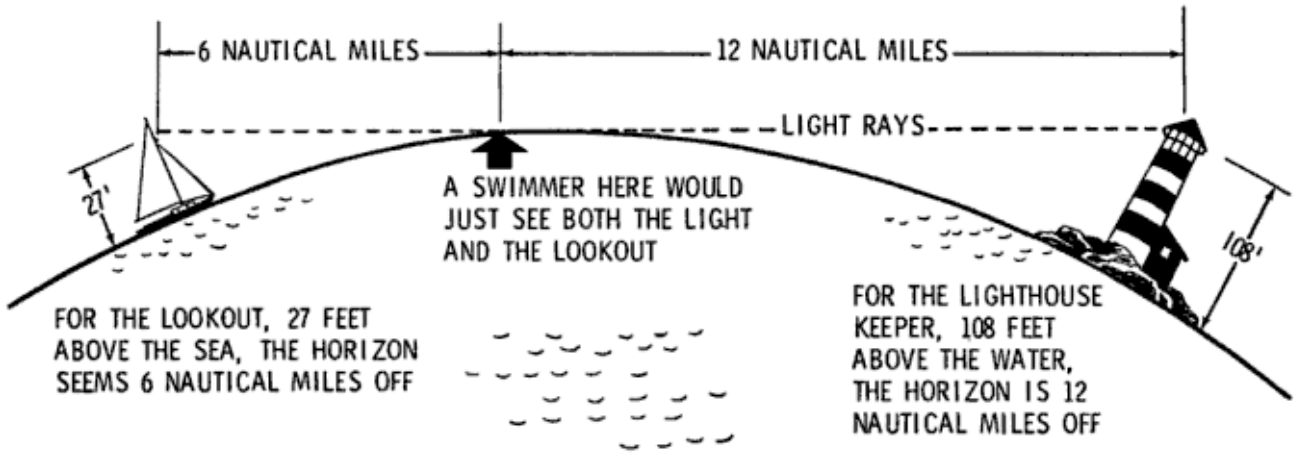
How far can you see?



Another formula, illustrated at the top of the page, can tell you the distance to the horizon. Actually, this depends on the height of your eye above the water, and there are tables giving the distance to the horizon for various observation heights. There is also a difficult formula that will tell you these distances, but it requires extracting a square root. The simple formula given here avoids this by attacking the problem from the opposite direction: How far above the water must you be to see a given distance?

This formula for visibility can be used with either nautical miles or statute miles, as described in the box at right, by simply changing the fraction.

For the man in an open boat, whose eyes are only three feet above the water, the horizon is two nautical miles away. In order to increase his range of visibility to six miles he would have to be 27 feet above the water, in the rigging of a sailboat perhaps.

Keep in mind this relationship between the height of your eye and the horizon when navigating at night. Charts give the height of the lantern of all lighthouses and their range of visibility, but the latter is figured on the basis of your eye being 15 feet above mean sea level. When standing in the cockpit, your eye may be only five feet above the water, in which case the horizon will be much closer, making it necessary to adjust the charted range of the light.

A third area where a simple formula can solve a problem is in figuring tidal levels. Wherever the time between high and low water is roughly six hours—a common interval—a smart skipper can calculate the water level in his head for any hour between high and low water.

On the rising tide, the level rises slowly at first, then faster, until at half time between tides it's half way between the two levels. On the falling tide, the same thing happens but exactly in reverse, as shown in the table on the following page.

If you operate a boat in tidal waters, you'll find many uses for a formula describing this, called the Rule of 1-2-3, 3-2-1. When the range of the tide is n feet, the water level rises or falls:

n inches in the first hour
2n inches in the second hour
3n inches in the third hour
(reaches half level after three hours)
3n inches in the fourth hour
2n inches in the fifth hour
n inches in the sixth hour

You can use this formula wherever the time between the last Low/High Water

Visibility

To see a distance (D) in *statute* miles, your eye eye has to be H feet above sea level.

THE FORMULA: $H = 3/4\ D \times D$

To see a distance (D) in *nautical* miles, your has to be H feet above sea level.

THE FORMULA: $H = 3/5\ D \times D$

Examples: To be visible 40 nautical miles away, a mountain would have to be 3/4 x 40 x 40, or 1200 feet high

To be visible 40 statute miles away, a mountain would have to be 3/5 x 40 x 40, or 960 feet high.

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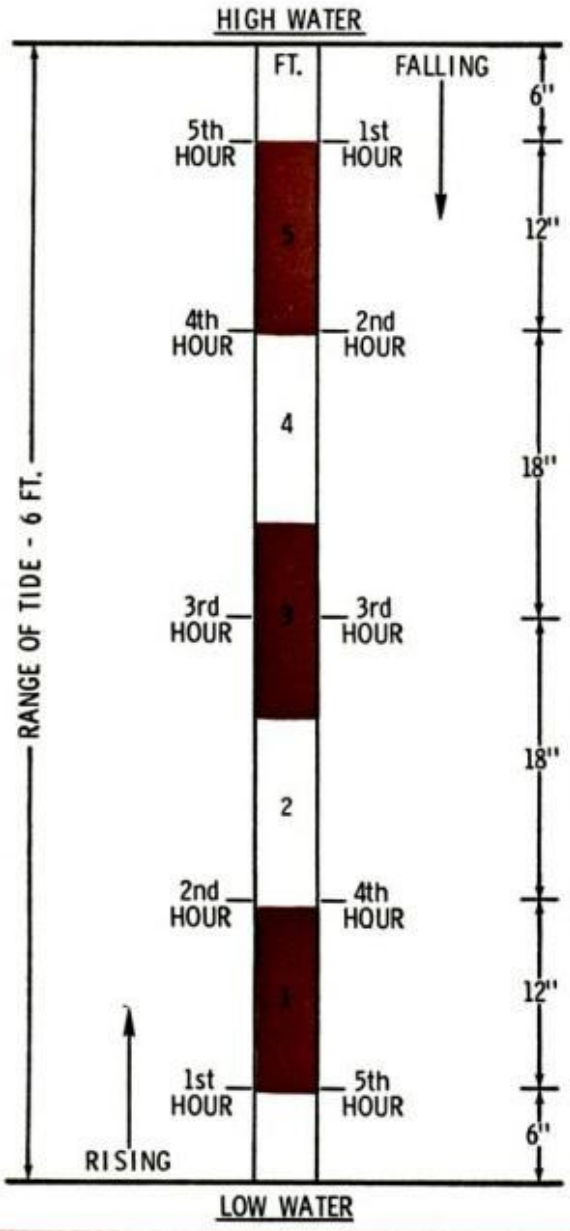
How much water right now?



HOURLY WATER LEVEL
BY RULE OF 1-2-3, 3-2-1

and the next High/Low Water is between 5½ and 6½ hours.

Say you have to cross a sandbank that at low tide is only 2 feet below the surface. Your draft is 3½ feet and the tide range is 4 feet. When can you cross with a 6-inch safety margin? It's easy. At half tide the level will be 2 feet above low water, sufficient for crossing, so you'll be able to cross safely three hours after low water.

On a dropping tide you shouldn't wait until three hours after high water, however. A tide slightly lower than predicted, due to offshore winds perhaps, would leave you high and dry for more than six hours. ★ ★ ★

Outboard Clinic

Q In removing and replacing spark plugs in my 1958 Johnson, I stripped the threads in the powerhead. What do I do now?—H.L.M., Mich.

A There are adapters available to fit into the stripped hole, both for the common 14-mm plug and the less common 18-mm plug. Most outboard service shops can take care of this job. If your local dealer can't handle it, however, try an automotive repair shop.

Q What do you think of the feasibility of installing a transistorized ignition in an outboard motor? The engine I have in mind is a 1962 75-hp. Evinrude.—D.F., Minn.

A Quite frankly, it's my understanding that transistorized ignitions have not yet proven themselves completely in automobiles, so I couldn't recommend such an installation at this time. You can always do it later if the system lives up to its advance publicity, but until then I'd sit on the sidelines and watch for developments.

Q Why can't I get more speed out of my 1953 10-hp. motor rigged to a 220-lb. boat? I've invested in a two-blade bronze prop and even had the head milled 35 thousandths.——G.E.K., N.Y.

A Any engine can give just so much, and the engine you now have wasn't built to provide the kind of power you seem to desire. I'd concentrate on the hull (weight, trim, bottom finish, etc.) rather than the motor. Or shop around for a more powerful motor.

As a service to the readers of *POPULAR MECHANICS* in solving problems relating to their outboard engines, you are invited to submit your questions to this column. All questions will be answered, either in the column or by mail. Address Outboard Clinic, Popular Mechanics Magazine, 575 Lexington Avenue, New York, New York 10022 and enclose a 5-cent stamp.

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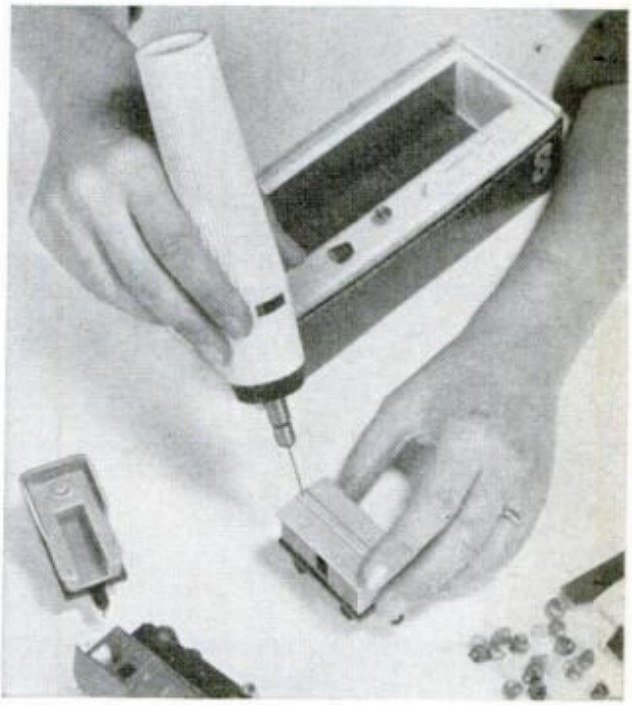
Shopping for Tools

By Robert B. Berger

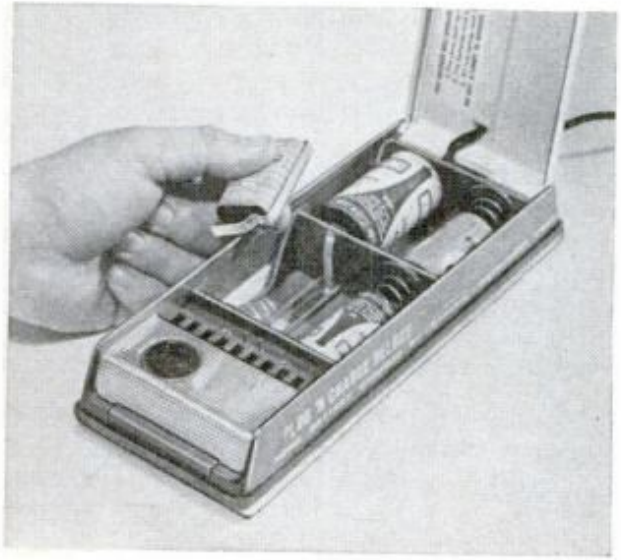
Inspection of Stamps, coins and small parts is easy when you use the Specto-Scope magnifier. The 20-power instrument has a built-in flashlight and a measuring reticle that superimposes the graduations directly over the magnified image. Postpaid prices are $9.75 with reticle or $7.85 without. Albert J. Tatu Co., P.O. Box 707, Naples, Fla.

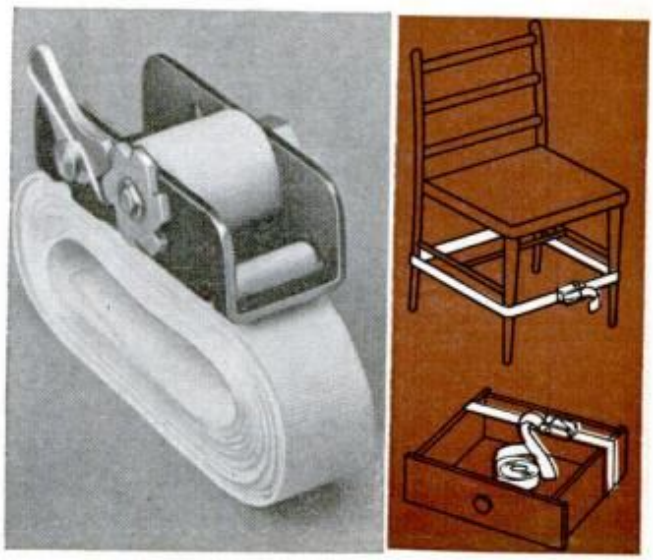
A Cordless Drill for delicate work on models, toys and jewelry is powered by two C-size flashlight batteries. The motor has a speed of 10,000 rpm. Two drill bits, a sanding drum, deburring tool and router are included in the kit which sells for $3.95, less batteries. Strombecker Corp., N. Pulaski Road, Chicago, Ill.



Web Clamp is Helpful when gluing drawers, chairs, doors or screens. The ratchet-action clamp is fitted with a 12-ft. 600-lb. test nylon strap that can be wrapped around the work and tightened with wrench or screwdriver. The cost is $2.98. Stanley Tools, 195 Lake Street, New Britain, Conn.

All Types of Dry Cell batteries in penlight, C-size, D-size, as well as 9-volt, can be recharged with the Plug 'N Charge unit. It can charge from one to four batteries of different types and sizes simultaneously. A battery tester is included with the charger, which is priced at $5.95. Dynamic Instrument Corp., 115 E. Bethpage Road, Plainview, N.Y.





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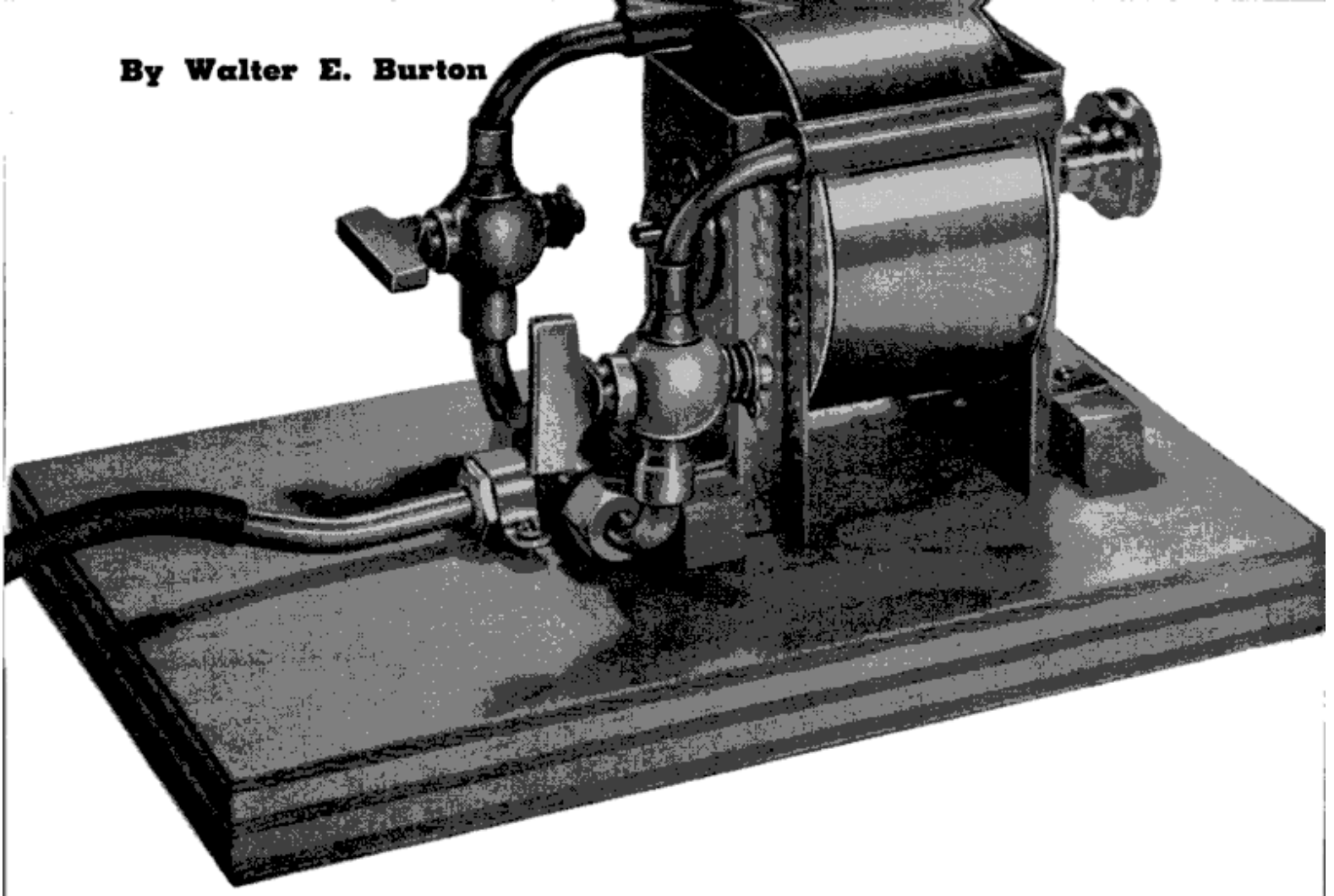
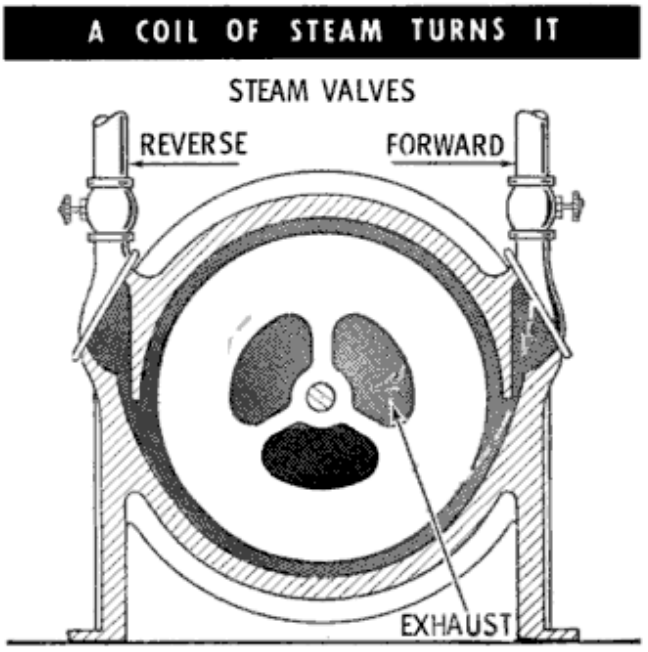
By Walter E. Burton



MAKE A MODEL Tesla Turbine

One of the great "lost" engines, Tesla's long-neglected turbine is due for a revival. It's a simple modelmaking project: no pistons, so no close tolerances! And it runs on air or steam



WE'RE HAUNTED by the restless ghost of Nikola Tesla. Last year, we told you how to make a model of that great inventor's high-frequency coil (page 169, June '64 *PM*). Now, here's his oft-mentioned but rarely seen steam turbine. These two models have more in common than their inventor: Though they're strictly for fun and experiment, both models are based on originals that (1) were built for sound practical purposes; (2) introduced revolutionary principles; (3) never got off the ground.

The sectional view at left shows how an actual prototype, built for a power com-

HOW IT WORKS is shown in sketch based on 1911 engineering reports of actual engine Tesla built for a New York power company. As steam from nozzle at right spirals between discs, its drag spins them

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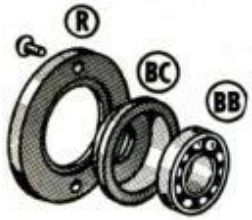
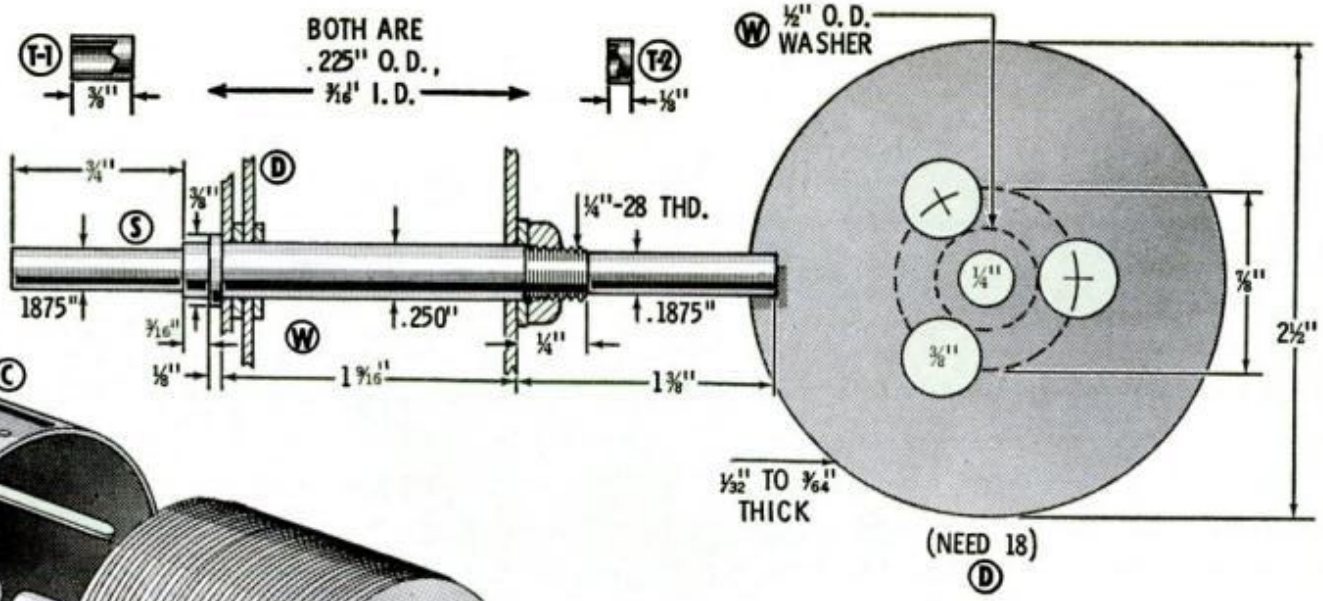
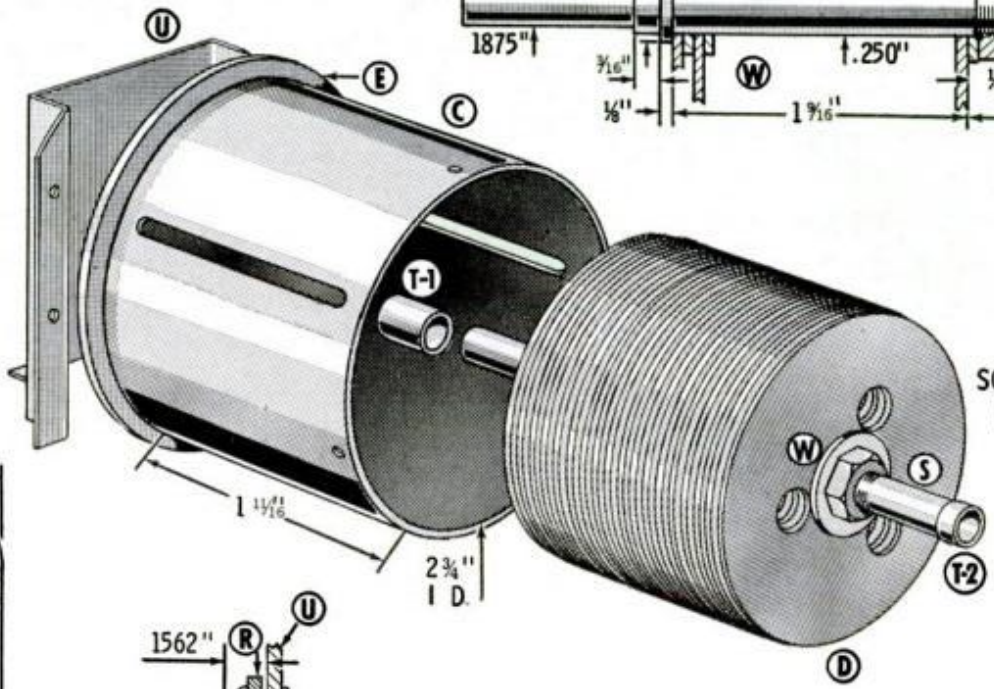
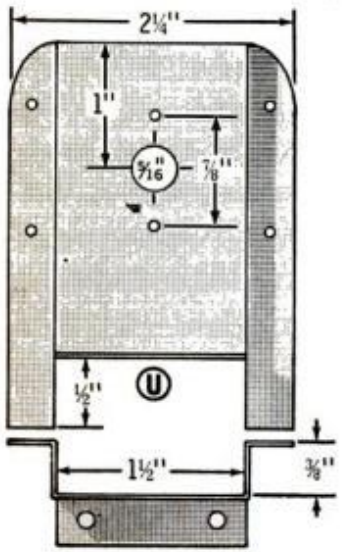
ROTOR ASSEMBLY is heart of turbine, consists of 18 metal discs spaced apart on shaft with washers of same thickness—all clamped snug against flange of shaft with ¼-28 brass nut. Align exhaust holes parallel to shaft. Sleeves, detailed at left, slip onto shaft to stop back-and-forth play between bearings

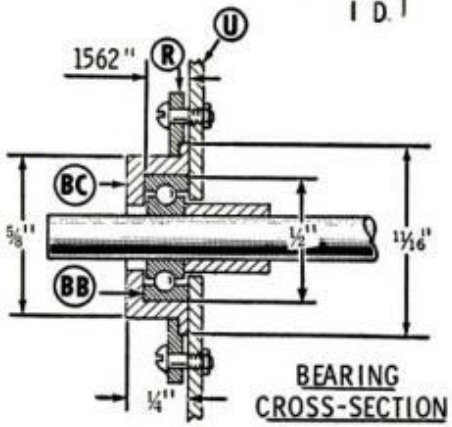




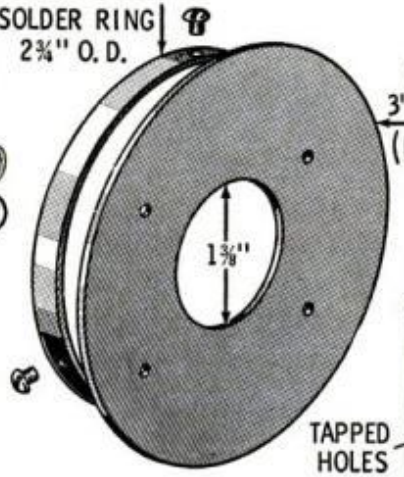


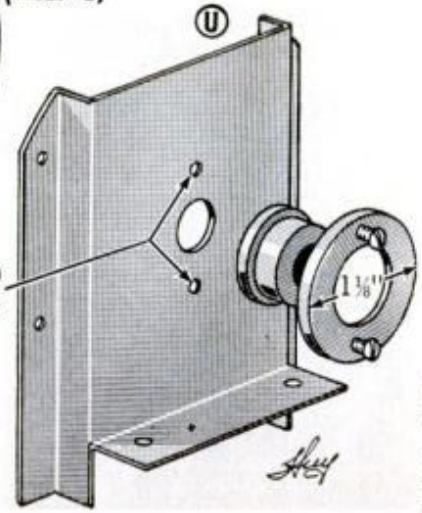
NEED 2,
BLANK BEFORE
BENDING 2⅞" x 3"





BEARING
CROSS-SECTION





HOUSING CYLINDER (C) should provide ⅛ in. or less clearance at edge of discs. One of end plates (E) is soldered to housing, other to ring which fits snugly within mouth of housing and is held with three short screws passed through housing and into holes tapped in ring. This gives access to rotor assembly

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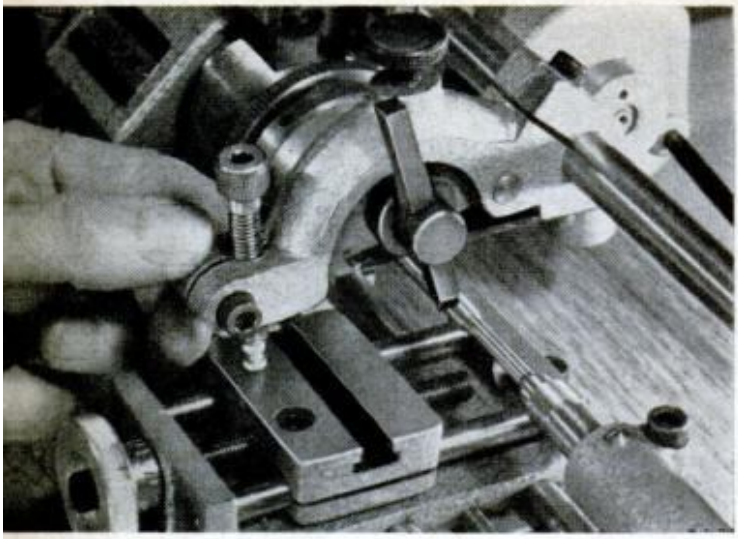
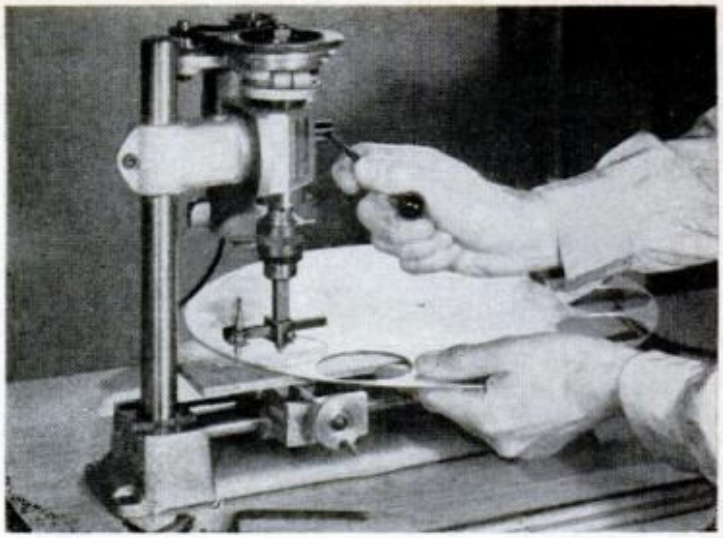
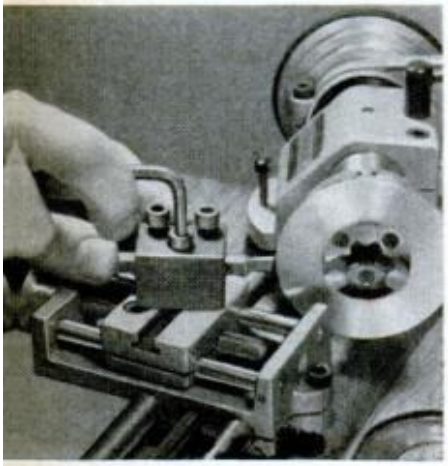


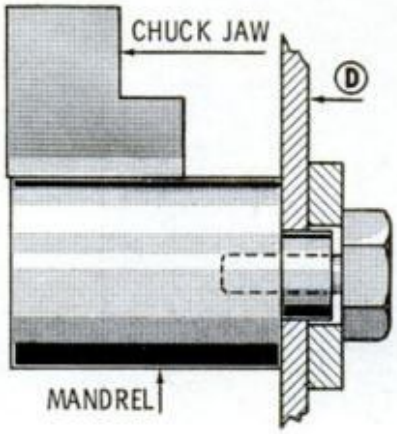


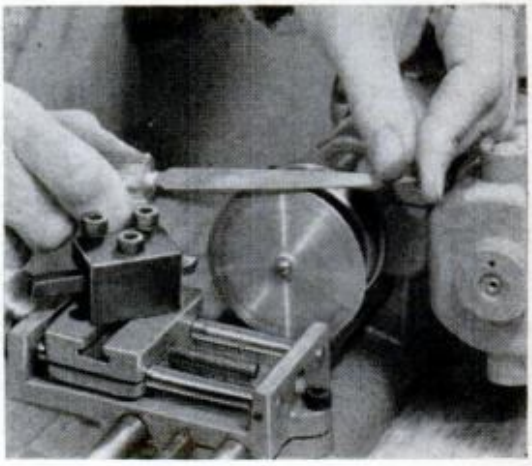
CUT, FOLD, TAPE

TESLA TURBINE

MACHINING THE SHAFT is three-step job. In left photo, ⅜-in. rod has already been turned down on one end, then flipped end-for-end to take down other end; right end of thicker center is then threaded as shown. In right photo, aluminum rotor discs are blanked out with drill-press circle cutter

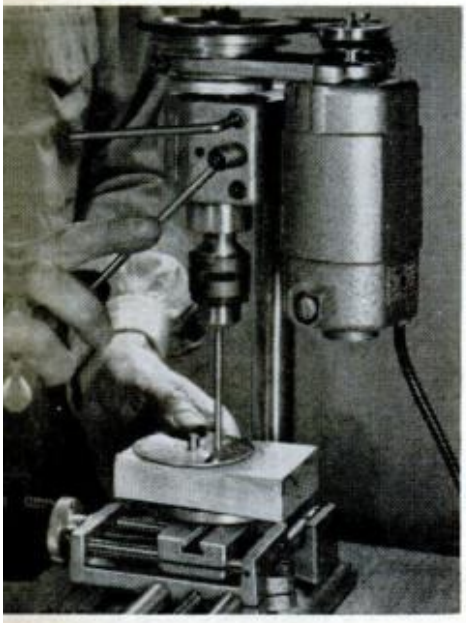


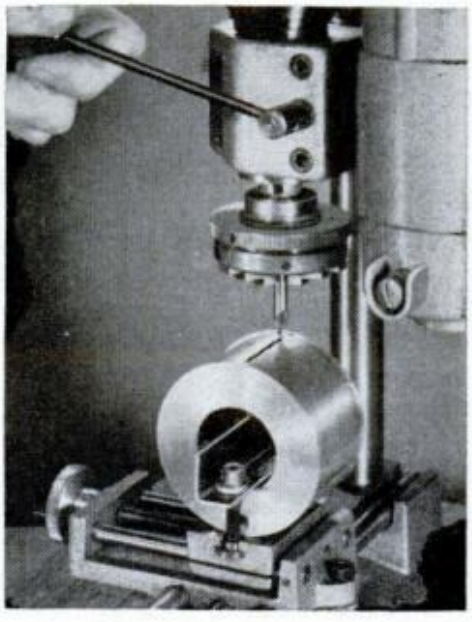


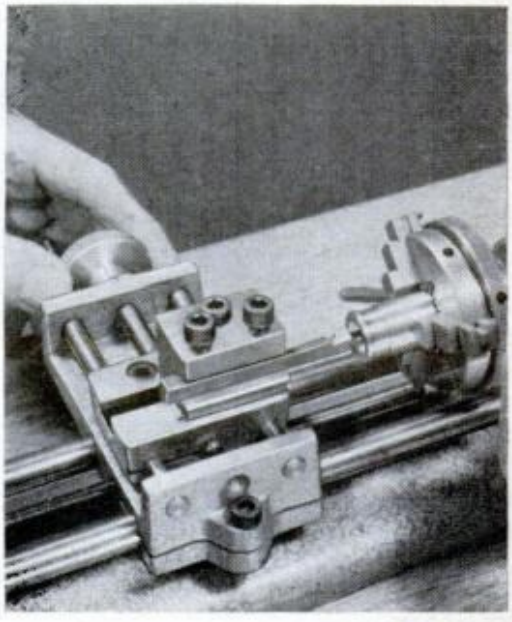


HOUSING ENDS (left) and rotor discs (right) are dressed to exact diameter with parting tool. Note that larger O.D. of ends requires pivoting headstock for clearance. Disc edges are rounded with flat file, polished with fine-grit abrasive cloth. While ends will mount on chuck, discs' center hole is too small; you must make up a chucking mandrel (center) with end tapped for bolt passed through washer and bushing

EXHAUST PORTS were drilled (left) with ¼-in. bit, then reamed to ⅜ in. Simple jig positions all holes same distance from center (120° spacing isn't critical). Air-jet slots were cut (center) by drilling series of holes with center bit, then using bit as milling cutter to clean out webs. Note angle-iron clamp to anchor housing. Slots were later filed to accept jet nozzles. At right, bearing caps are machined from brass rod







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pany, worked. It had 25 discs 1/32 in. thick, and though it measured only 2 ft. by 3 ft. and stood only 2 ft. tall, it produced 200 horsepower at a speed of 16,000 rpm on a 125-lb. steam pressure. The spiral path of the steam was as great as 16 ft., and the pressure of the *exhausting* steam was as low as 1 psi—proof of the turbine's remarkable efficiency.

The other feature that created a lot of excitement at the time (pre-World-War-I) was the ease with which the engine could be reversed. You simply fed the steam to a nozzle on the opposite side of the rotor shaft. Standard turbines of that day could only be reversed through a complex, clumsy process.

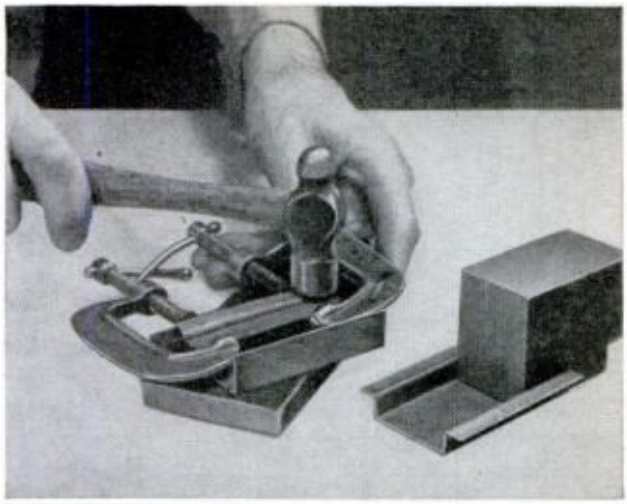
But Tesla's turbine never went into commercial production. Maybe it was just ahead of its time. There are hints that interest in it is reviving; the Navy Department is taking a fresh look at the turbine, for example. It may yet become an important power unit—perhaps in conjunction with atomic steam plants.

The operating principle that stimulated all this abortive interest in 1911 is beautifully demonstrated in our model. The Tesla rotor consists of parallel discs on a shaft, spaced apart a distance equal to or slightly greater than their thickness. In Tesla's full-sized turbine, these discs were of hardened steel; but since you'll be operating the model at only modest pressures you can use easily-worked aluminum.

A jet of air (or steam), directed toward the edge of this rotor assembly, spirals around the spaces between the discs in an effort to find the central escape ports. The drag of the gas against the faces of the discs causes the entire rotor to spin.

Our model perches its 35-oz. weight and 3½-in. height on a 5 x 8-in. platform of ¾-in. plywood. If you're going to run it on air, you can make the turbine out of almost any metal, using a tin can for the housing (C) and cold-rolled steel for the shaft (S). But if you plan to introduce steam, you'll want a housing of aluminum and a shaft of stainless steel. All the machining for a model of this size can be done on a small metalworking rig, such as the Unimat shown in all photos, left.

The housing cylinder for our model was cut from an old brass fire extinguisher. If the cylinder you choose is oversize and must have a segment removed—or if you have to make a cylinder out of flat sheet—join the ends with a metal strip riveted across the joint and sealed with solder. If you make the housing of aluminum, assembly can be by means of riveted brackets, instead of soldering. At any rate, it's a good idea to leave one end plate detachable so you can adjust the rotor, later.



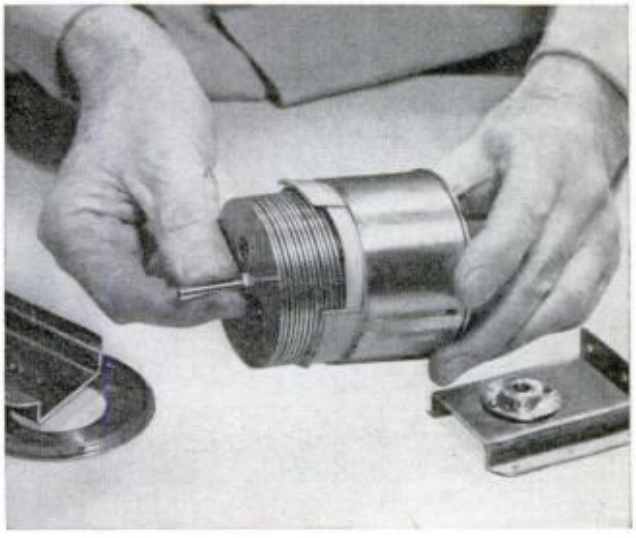
BENDING UPRIGHTS is easy if you have steel blocks of proper size. Before bending, drill holes for attaching to base and housing, and mounting bearings. If brass gets too hard, heat it red and quench it

The housing is suspended between two uprights (part U) which also support the rotor bearings. The uprights should be made of fairly stiff material, such as 18-ga. (.0403-in.) brass. Four short 2-56 screws attach each upright to the end plate. In our model, these parts are polished to an "engine-finish" by means of an abrasive-rubber rod chucked in a drill press. The channel between upright and plate lets exhaust escape.

Fafnir No. 33K5 ball bearings were used on the model shown; this bearing has a ½-in. O.D., a 5/32-in. width and a 3/16-in. bore. If similar bearings are not available, you'll have to alter affected dimensions—or machine solid sleeve bearings from ¾-in. bearing-bronze rod.

Whichever type of bearing you choose, attach it to the upright with a couple of 2-56 screws through a retaining ring and into tapped holes in the upright. Lock

CENTER ROTOR in housing with cardboard shims, then position uprights (with bearings already mounted) against endpieces and mark latter for mounting holes. Disassemble, remove shims, drill and tap holes



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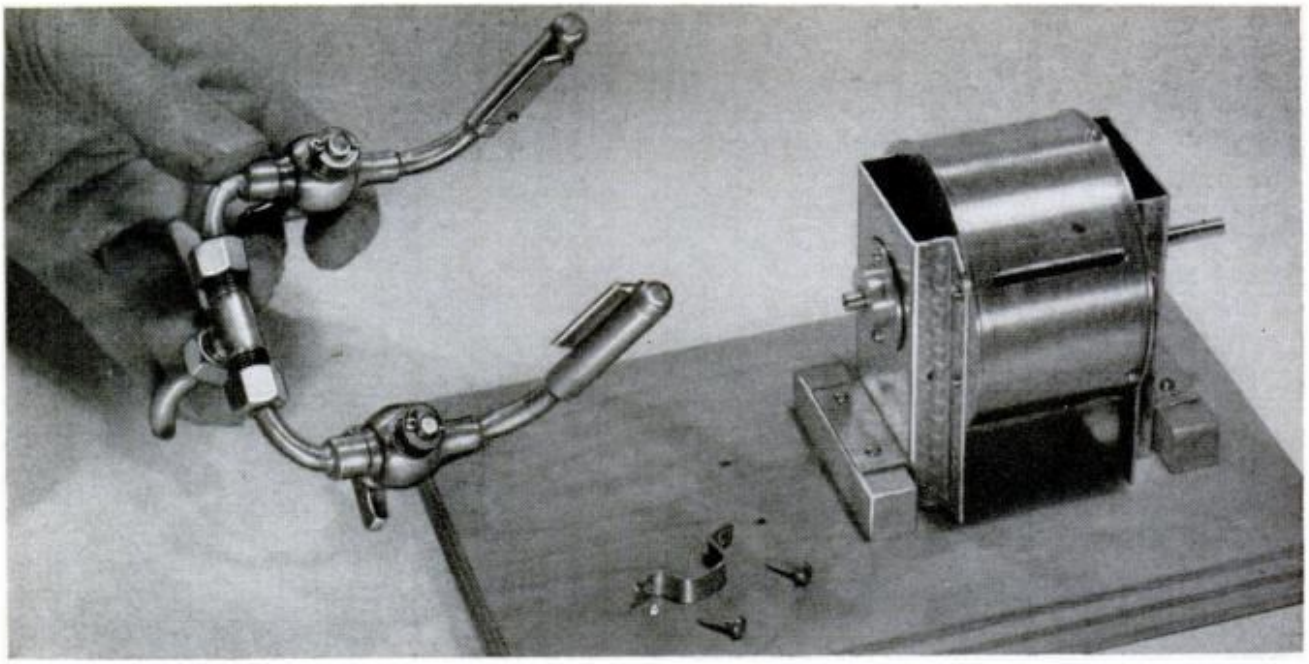

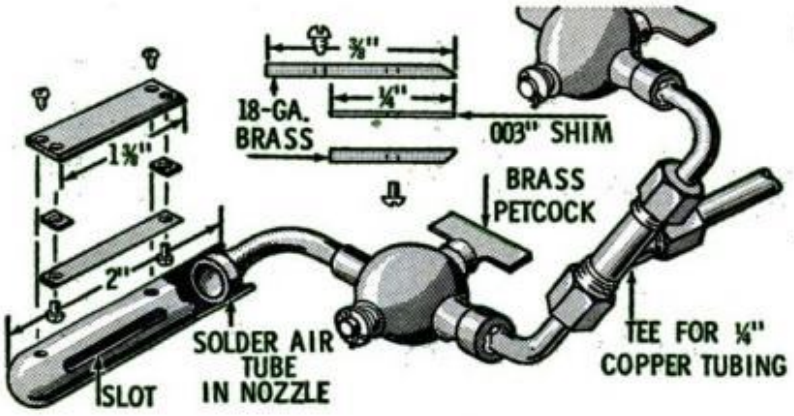

NOZZLE ASSEMBLY is mounted on base with U-shaped clamp. It consists of (l-r in photo) pipe onto which rubber tube from air-source slips; tee to fit copper tubing that's soldered to pair of petcocks; and jet nozzles soldered on other "elbows" of tubing. Jet slots in air boxes and engine housing are about 1 in. long, filed wide enough to accept nozzle unit detailed at left

washers on the inside keep the screws from backing off under vibration. Note in the cross-section on page 189 that the retaining rings are recessed for the bearing cap but not set tight against the upright.

Positioning the bearings with respect to the rotor shaft is demonstrated in the bottom photo on the previous page. After the bearings are mounted on the uprights (centered over the 5/16-in. holes), place the rotor in the housing as shown, press the loose end plate in place, and suspend the shaft between the bearings to locate the mounting holes in the end plates. If the shaft won't turn freely when the assembly is complete, change the bearing alignment by loosening or tightening the retaining ring screws, or by inserting shims between uprights and end plates.

Remember, too, that discs and washers must be flat; one way to flatten them is to sandwich each one between steel plates, before assembly, and strike the top plate with a hammer.

The air boxes shown above were made from 1/8-in. brass electrical-fixture pipe. One end was notched, hammered inward to form a closed dome, and sealed with solder. You can save yourself this step if you can locate 2-in. sections of pipe or tubing with one closed end. The discharge port should be a slot about 1 1/8 in. long and 1/32 in. wide—or it can be a series of closely-spaced 1/32-in. holes, instead. Now, weld *over* each discharge port a nozzle formed by screwing and welding plates together with edge-shims to form a slit, as shown in the sketch.

The slots in the housing (C) that take these nozzles should be cut after the jet assembly is complete. They're located at about the 10 and 2 o'clock positions (think of the end plates as clock dials). Direction of rotation depends on which jet is turned on, so petcocks are soldered into the feed lines. To simplify the unit, you can make a single nozzle for one-direction operation. This could be soldered directly to the housing slit.

This model is not intended for high-speed operation on high-pressure air or steam. Under such stress there might be hazards involving tensile strength of rotor discs and other parts. But the model shown has run merrily for months when hooked directly to a 1/4-hp air compressor; at comparable pressure, it will perform similarly on steam. ★★★

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MATERIALS LIST

PART	KEY	AM'T	DESCRIPTION
Uprights	U	2*	18-ga. brass 2⅞" x 3"
Housing	C	1*	Cylinder approx. 2¾" I.D. x 1¾"; or 18-ga. brass 1¾" x 8¾" to form cylinder
Housing ends	E	2*	18-ga. brass 3" x 3"
Solder ring; air-tee strap clamp		1	18-ga. brass ¼" x 12" makes both
Shaft	S	1	⅜" x 4" c.r. steel rod (or stainless alloy)
Rotor disks	D	18**	18-ga. aluminum discs 2½" dia.
Rotor washers	W	20**	18-ga. aluminum discs ½" O.D.
Nut		1	¼"-28 brass hex
Bearing caps	BC	2	¾" brass rod, 1" long makes both
Bearing-retaining ring	R	2	18-ga. brass (or heavier) discs 1⅛" O.D.
Ball bearing	BB	2	Fafnir 33K5 or equivalent
Rivets		12	Small brass escutcheon pins, or equivalent
Screws		18 6	2-56 x ¼" R.H. brass machine; four matching nuts #3 x ½" R.H. wood
Sleeves	T-1, T-2	4	¼"-O.D. copper tubing reamed out with No. 12 twist drill
Air boxes		2	⅛" brass pipe 4¼" long
Air-jet plates		4*	18-ga. brass blank about 1½" x 1½"
Spacing washers		4	Bronze shim stock 0.003" x ¼" x 1"
Tubing		14"	¼" copper
Tee		1	To accept above tubing; or make a "T" or "Y" arrangement by hard-soldering pieces of tubing
Petcocks		2	Small brass, as shown in photos
Sleeevs for joining petcocks and tubing			About ¾" of ¼"-I.D. copper tubing
Base		1 2	¾" x 5" x 8" plywood or solid stock ½" x ½" x 2½" wood blocks
Small brass or aluminum pulley		1	3/16" bore

NOTES:

* Total size of brass sheet for parts C,E,U, etc.: 5½" x 12"

** Total size of aluminum sheet for disks, washers: 11½" x 14"

NEXT MONTH IN SHOP AND CRAFTS

★ **ALL YOU NEED TO KNOW ABOUT CUTTING GLASS.** It's a lot simpler than you think, especially if you take advantage of the tricks used by professional glaziers. The October issue of *PM* includes a complete course in glass cutting, from the proper way to run a perfect score in any kind of glass to special tips for cutting inside and outside circles. Don't miss it

★ **MODELING THE F-111.** Launch it with the wings pulled back to full-swept position next to the body, and as this silhouette TFX model zooms through the air the wings will slowly move to a fully extended position for a gentle glide back to earth. Or lock the wings at various angles to experiment with performance. The October issue contains complete plans

★ **"BUILT-IN" STORAGE WALL.** Home owner and apartment dweller alike will go for this portable storage wall which looks built-in but really isn't. For it means that you can take it with you—at least when you move. Stackable, box-like components tied together with a lighted overhead valance, convert any "unemployed" wall into a highly efficient working wall with shelves and niches galore for everything from books to your TV. Easily adaptable to your own requirements from complete plans in the October issue

★ **YOUR RADIAL SAW CAN SHARPEN ITSELF.** It's easy with this clamp-on saw-sharpening jig. Just mount a grinding wheel on the saw arbor, mount the blade on the jig arbor and go to work. It's designed to fit any make saw, hold any blade. Does a perfect "filing" job

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INTERFLEX

Build this unconventional speaker system that splits the music on your hi-fi records so you can pick out each instrument in the orchestra

By Earl Stowell

HERE'S A REALLY NEW SPEAKER SYSTEM for the reproduction of hi-fi and stereo sound. It took many years of research and testing to develop and now, for the first time, Interflex sound is being presented to the readers of *PM*.

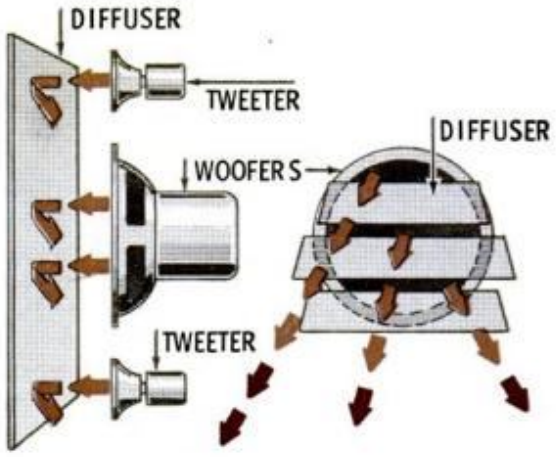
Interflex does many things. It separates each voice and instrument. It spreads the sound over the entire listening area (there are no sound beams or favored spots). It works from your existing mono or stereo amplifiers. It provides the effect of being in the hall in which the original program originated. Yes, an orchestra sounds like a band in your tiny living room—in effect, it seems to join your room to the original hall.

It retains excellent reproduction of whisper-soft or crashing volume. It reproduces the highest frequencies, but without the jangly effect so common in outfits that sound as if music were being reproduced from a tightly-stretched sheet of thin steel.

Inexpensive speakers and ordinary amplifiers produce amazing results. Of course, if they are not capable of reproducing the many overtones of a violin or piano, Interflex will not fill this gap. I heartily recommend the finest speakers and amplifiers you can get.

Interflex starts by reflecting the speaker output off diffusers which direct each

OUT OF THE DIFFUSER SLATS comes the output of one woofer. The other woofer and the two tweeters feed the big diffuser which reflects sound into room



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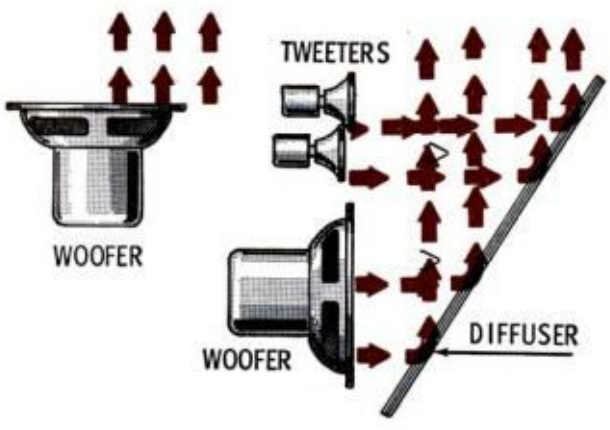
frequency into the room in a dispersed beam, but at a slightly different angle from every other frequency. Wonderful instrument that it is, the ear assembles these frequencies into their proper places.

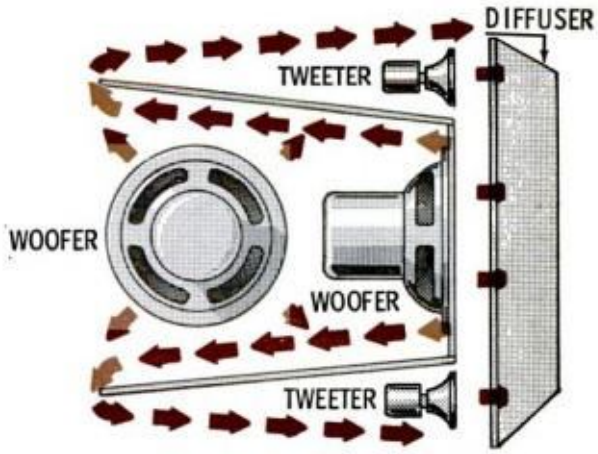
Also, Interflex uses a pair of folded horns of different lengths. Because of the elasticity of the air and the type of loading used, they act as an infinite number of different-length resonators, both quarter-wave closed and half-wave open, to that part of the sound energy reflected back into the tapered horns. They also act as eighth-wave closed resonators to trap some energy between 45 and 90 cycles per second, eliminating speaker and cabinet resonance in this range.

A discontinuity in each horn gives a bass-reflex action and causes the dual effect of acting as quarter-wave and half-wave resonators. Diffusers inside the cabinet eliminate the need for cabinet padding and add to the effect gained by crossing the sound beams of two speakers at critical angles to produce the beats that give original-hall sound. This effect can be used because sound waves are longitudinal instead of transverse. A special back-loading device adjusts to tune out the last trace of cabinet resonance.

ANOTHER VIEW OF SOUND TRAVEL. This time we look down from top of cabinet. Diffuser does much more than reflect sound into surrounding air



FOLDED HORN EFFECT becomes clear when you look from back. It reinforces direct flow shown in other sketches. Some sound goes through bottom port



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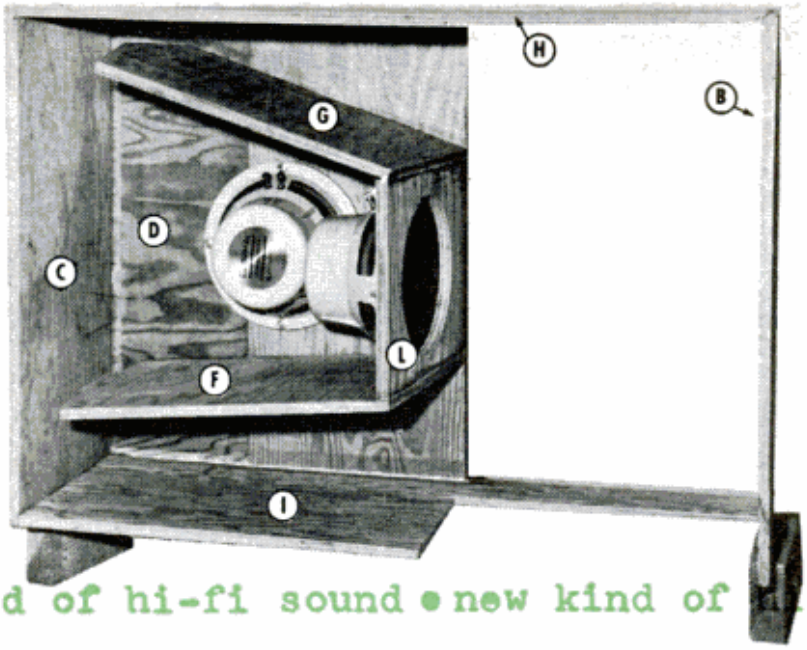

PARTIAL ASSEMBLY VIEW of cabinet shows both bass speakers mounted in place. Install the tweeter packages next. When all speakers are mounted, you can assemble remaining parts of the Interflex building block kit

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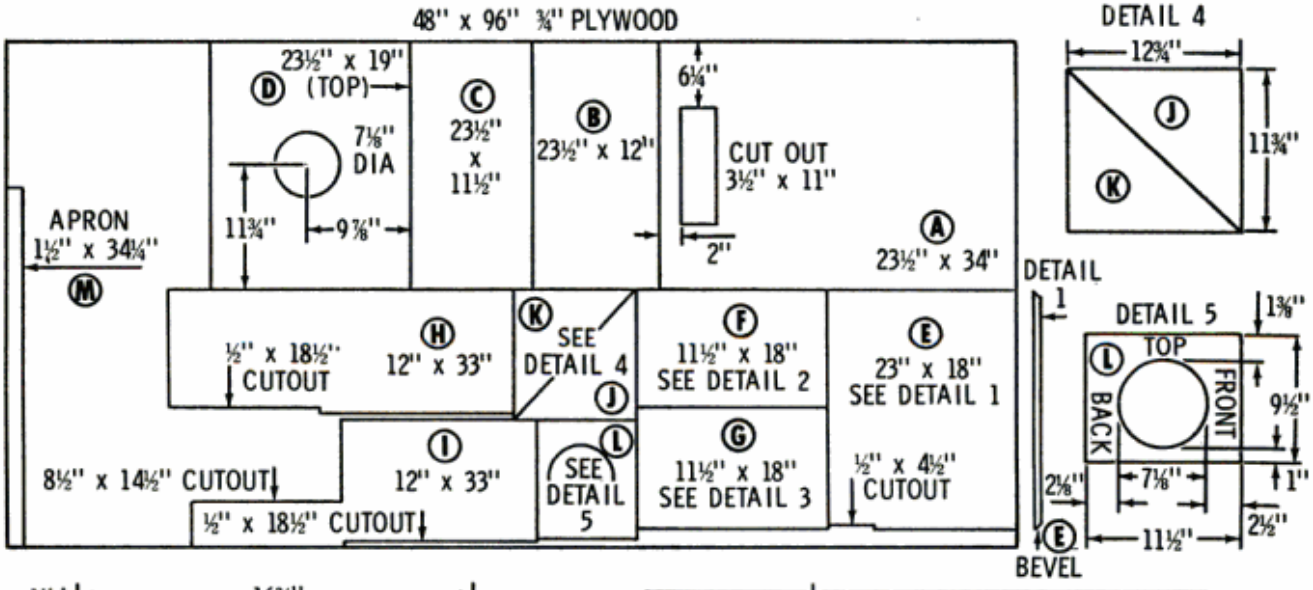

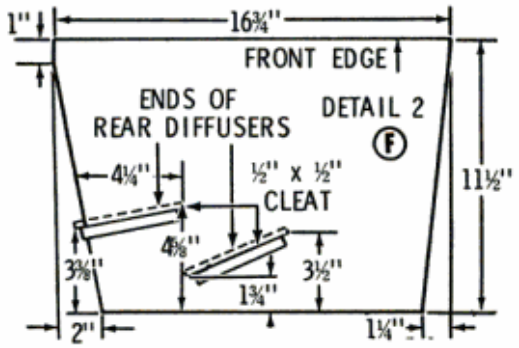

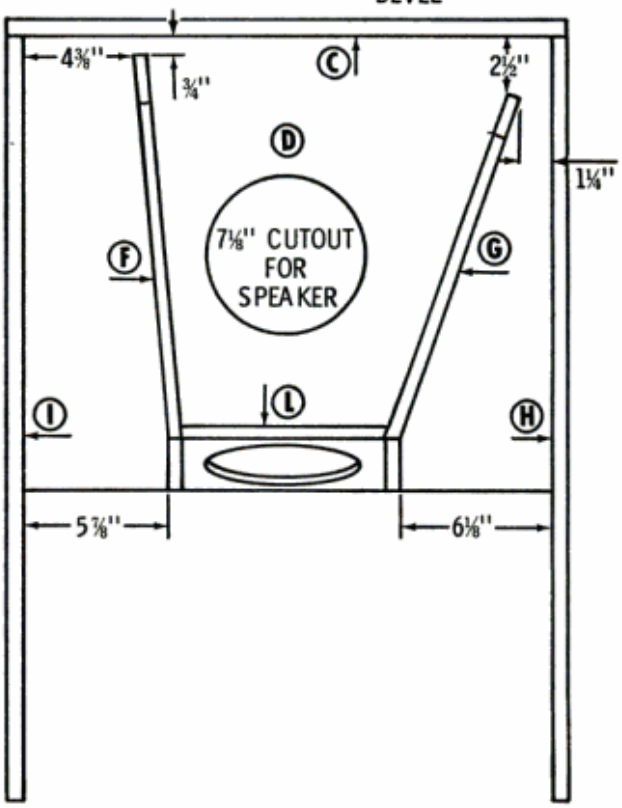

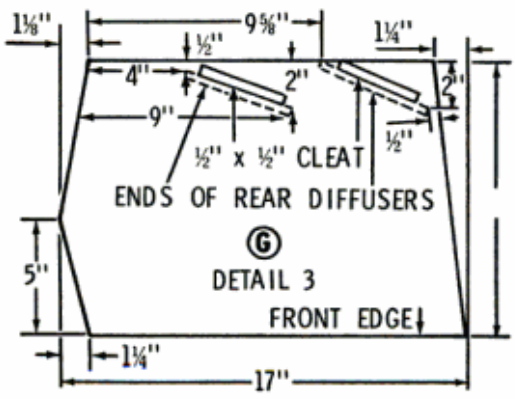

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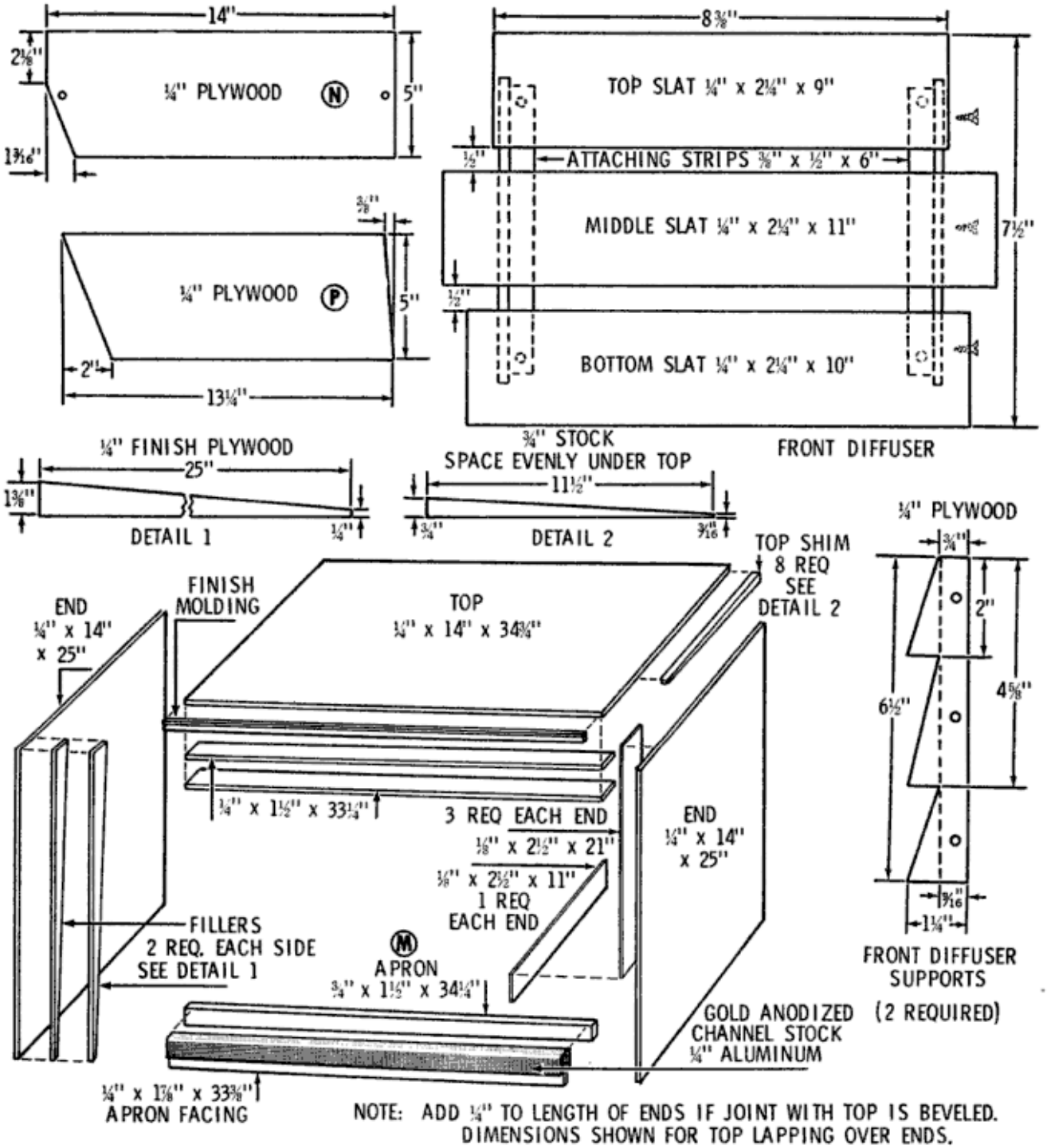
The sketches and photos give details of the best Interflex system designed to date —intended for the person who wants a fine system. There are others as small as a cubic foot. Some will even fit a table-model radio to improve its tone quality and sound distribution.

This system is designed around Electro-Voice SP8B speakers and the Electro-Voice BB1 building block kit which contains a driver, crossover network, brilliance control and wiring harnesses.

The backloading device is a port in the back (A), covered on the inside with a 2-in.-thick pad of spun glass between two layers of ¼-in.-mesh hardware cloth. Ten screws used around the edges compress the spun glass until the speakers work against the same load, front and back, as evidenced by no cabinet rumble or boominess. Compressing the spun glass down to just under an inch will be about right.

Use plenty of glue on all joints. Before closing the cabinet, fill the cracks between horn sides (F & G) and speaker panel (L) with wood dough or putty. A ½-in. crack at this point would act as a trap to a note with a 4-in. wave-length. Install the back with 1 or 1½-in. wood screws spaced 4 to 5 in. Do this across the back



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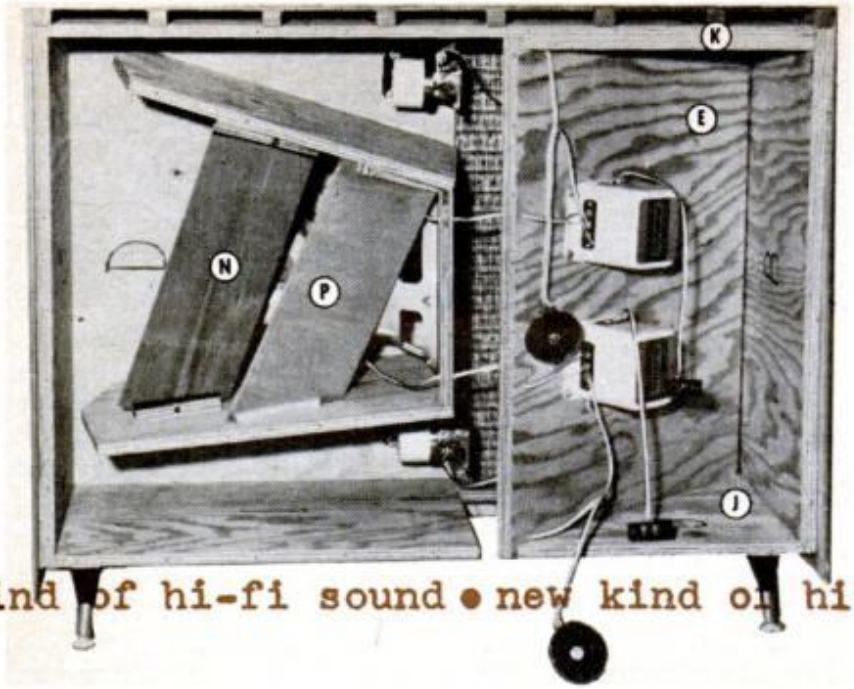


BEFORE ATTACHING COVER in rear, a last look inside shows completed cabinet. Crossover controls are still to be mounted along with the speaker connection terminal strips. All wood parts of the main cabinet are coded to match earlier sketches

w kind of hi-fi sound • new kind of hi-fi sound • new kind of

of main diffuser E (see photo above), too.

The bottom opening is part of the low-frequency trap. If you use the cabinet in upright position, cover the opening with hardware cloth and grille cloth and allow about 3 in. between this face and a wall.

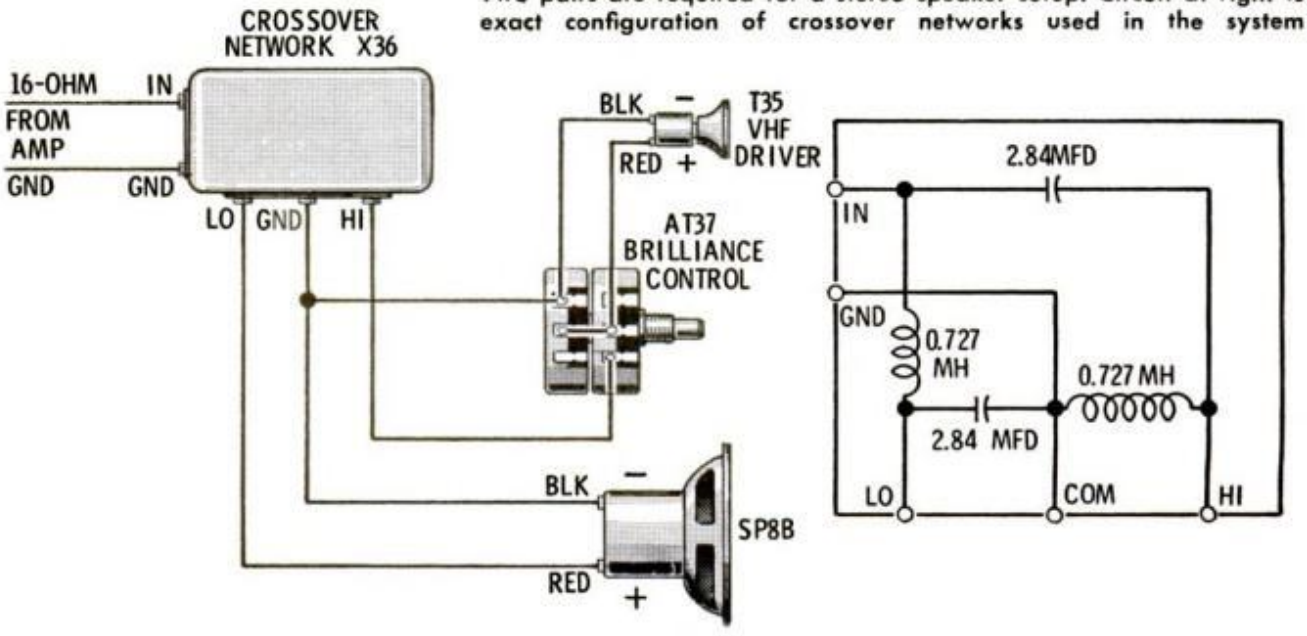
A word about the front diffuser, important to overall results. If you use the cabinet upright, rotate this diffuser 90°.

If the cost of all four speakers is prohibitive, do not settle for economy-grade speakers. Buy one good speaker and mount it on panel L. Cover the opening on panel D with a piece of plywood. When you can afford it, buy and install one of the tweeter packages. Later, add the second speaker and the second tweeter.

To use Interflex with a mono outfit, parallel the two speaker channels and connect them to the 8-ohm output of your amplifier. For stereo amplifiers, connect the left-hand channel to the speaker on panel L and the right-hand channel to the other speaker channel. Check phasing by reversing the leads to one speaker channel (with power off the amplifier to protect your tweeters). In Interflex, phasing is very important and you will have no trouble telling which way is correct. One way is warm and full; the other is shrill.

When your system is finished, give the cabinet a week to mellow. Sure, it is heresy to make the cabinet a part of the system; but the longer you use your Interflex, the more the cabinet will mellow. Then turn your system down to whisper-soft level. You will be amazed at the reproduction. Happy listening. ★★★

ELECTRONIC CIRCUIT SHOWS HOOKUP of one of two speaker pairs. Two pairs are required for a stereo speaker setup. Circuit at right is exact configuration of crossover networks used in the system



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Balls O'Fire

(Continued from page 119)

cast-off furniture lining the walls.

One end of Spooksville is devoted to the museum—mainly clippings from local newspapers and letters requesting copies of the "Tri-State Spook Light" booklet sold for a dollar. Dominating the center of the room is a fold-away, the bed of Spooky's assistant, Warren Harmon, a raspy-voiced backwoods promoter.

Spooky Meadows, 71, is a kindly, outback philosopher with a clean, but unpressed shirt and a Tyrolean hat. He rolls his own from Half & Half pipe tobacco, and often fails to end his sentences. He's composed an interminable song about his beloved Spooklight, which he'll sing for you—quavering, but with gusto—at the slightest show of interest.

Can It Be Hoodoo?

Old Spooky can't be pressed into giving many opinions on the light. When pinned down, he says, "What is it? That's easy; it's a light. But we don't know what causes it." Then adds, as though settling the matter: "It's more or less a hoodoo."

One big problem in tracking down the answer to Spooklight's riddle: It's tough to get at the truth through the local people. Some simply like to embroider when visitors are around. Others have convinced themselves over the years of things that can hardly be true.

For example, Neosho (Mo.) Daily News editor Joe Taylor says, "I've seen it come up on you so it illuminates the area," then adds as a disclaimer: "But that is very rare."

Expounds the Joplin Chamber of Commerce in a mimeographed flyer: "Spooklight . . . began appearing in the year 1880. It created panic in the small neighboring village of Hornet . . . Early settlers actually left their homesteads in terror because of the giant ball of light bouncing over the hills and across the fields."

Gregory Briones of Seneca claims that one morning about three he "turned around and there it was just a'sitting there on the back of the car. It throwed off a good bit of light, like an electric bulb close up to you. I took off in one big hurry."

A man who once lived near the light, Bill Youngblood, proclaims that it used to appear outside his window. "It would just bounce around out there and keep me awake at night," he said, his round face all innocence. "You know, like someone would be out there with a big ol' light, and sort of waving it around."

Most of the natives have theories to back up their tales, and the theories are as numerous as are the neighborhood stills. One local woman claims that early this century a miner "came home drunk and threw his baby into the fireplace. His wife waited until he fell asleep, then cut off his head with an axe." Spooklight is this guy looking for his head, she says. Other theories:

* *A light rigged for effect.* Remarked a college student who saw Spooklight on one of the nights I was there: "The whole thing's a crock. That old man has a light he turns off and on." All night long? A light nobody can find?

* *Swamp gas.* Such flammable vapors as methane (CH_4) occasionally are found in swampy or marshy places. Neosho Daily News editor Taylor believes one of these is the cause. But such gas doesn't ignite itself, and if lit, quickly burns out or blows away.

* *Will-o'-the-wisp.* This phenomenon probably is biological luminescence caused by bacteria, fungi, and perhaps insects. But the light is dim, much too dim to match Spooklight's intensity.

* *Mineral glow.* A state cop from Quapaw told me that "the light simply is from diggings left over from mining." His opinion is shared by others. The area *is* rich in rockpiles where lead and zinc had been mined early this century, and the people think Spooklight is produced somehow by "electrical action" of these deposits.

* *Man-made lights.* In 1945 Dr. George W. Ward, formerly with National Bureau of Standards, visited the site and theorized on "the possibility that the cause lay in the refraction of automobile headlights." But he tempered his thoughts because "the relative humidity and temperature would have to attain the correct values to produce the correct density of atmosphere to bend the light sufficiently for observation." Comments Henry H. Hicks, professor of mechanical engineering at the University of Arkansas, who, at the suggestion of Popular Mechanics, took a preliminary look at the light: "I rather doubt that atmospheric refractions could cause the effect [because] refractions are subdued at night. . . ." In his opinion, the light is "some kind of fixed light, perhaps a billboard light, [but] some of the mechanisms are not clear."

At the head of the lane, Spooky Meadows has set up a 25¢-a-look telescope inside a little tin shack on stilts. It's a good make, has an objective lens of about three inches. But it's rigged so that viewing is done through a ½-in. hole in the wall. The resolving power is ruined. "Keeps the rain off," he explains.

(Please turn to page 208)

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Balls O'Fire

(Continued from page 207)

He pointed out where Spooklight usually is seen at night—alongside a line of three telephone poles rising over a hill in the distance. With a lensatic compass I found that the poles were slightly south of due west. Then I set off to find them.

The poles were three miles down the road, at the crest of that last hill from which you can see lights from Quapaw.

The solution to the mystery began with the arrival of Jean Prideaux, instructor in mechanical engineering (specialty: fluid dynamics) at the University of Arkansas and colleague of Prof. Hicks. He had a telescope with him, a cleanly made, 60-power refractor constructed by Hicks.

Ordinarily you view Spooklight from three miles back on the road, and the trees act as sights. But here, out in the open, it was difficult to find which of the distant lights actually was Spooklight—if any were. They all pretty much looked alike. But using the compass readings I had gotten back in the shack, we lined up the scope as best we could, and looked for that peculiar golden color.

View of the Spooklight

Suddenly, there was Spooklight, centered in the scope.

Or rather spooklights. There were a number of sets of them—each set two light, one beside the other. They appeared slowly to crawl down the darkness in a wiggling, peculiar snakelike pattern. Sometimes there were only a couple of pairs; other times there were as many as eight, shimmering and vibrating as though shining through "heat waves."

Seen with the naked eye they blended into a single light, the brightness varying with the number. Through a pair of good field glasses, the light separated into a number of single dots. But through Prof. Hick's telescope, they resolved into what looked like car lights.

Was the mystery essentially solved? If so, where were the cars?

With the telescope still focused on the lights, we waited through the night. From 3:30 to 4:00 I made a sample count: 15 double sets of lights.

Haze hovered over the valley as the sun edged into view. Through the scope—still pointed at Spooklight—we could see nothing but blurred outlines. By mid-morning, the haze had burned away enough that we could see what looked like a gravel road rising up from the Spring River bottoms. (We learned later that haze almost never leaves the section entirely.)

(Please turn to page 211)

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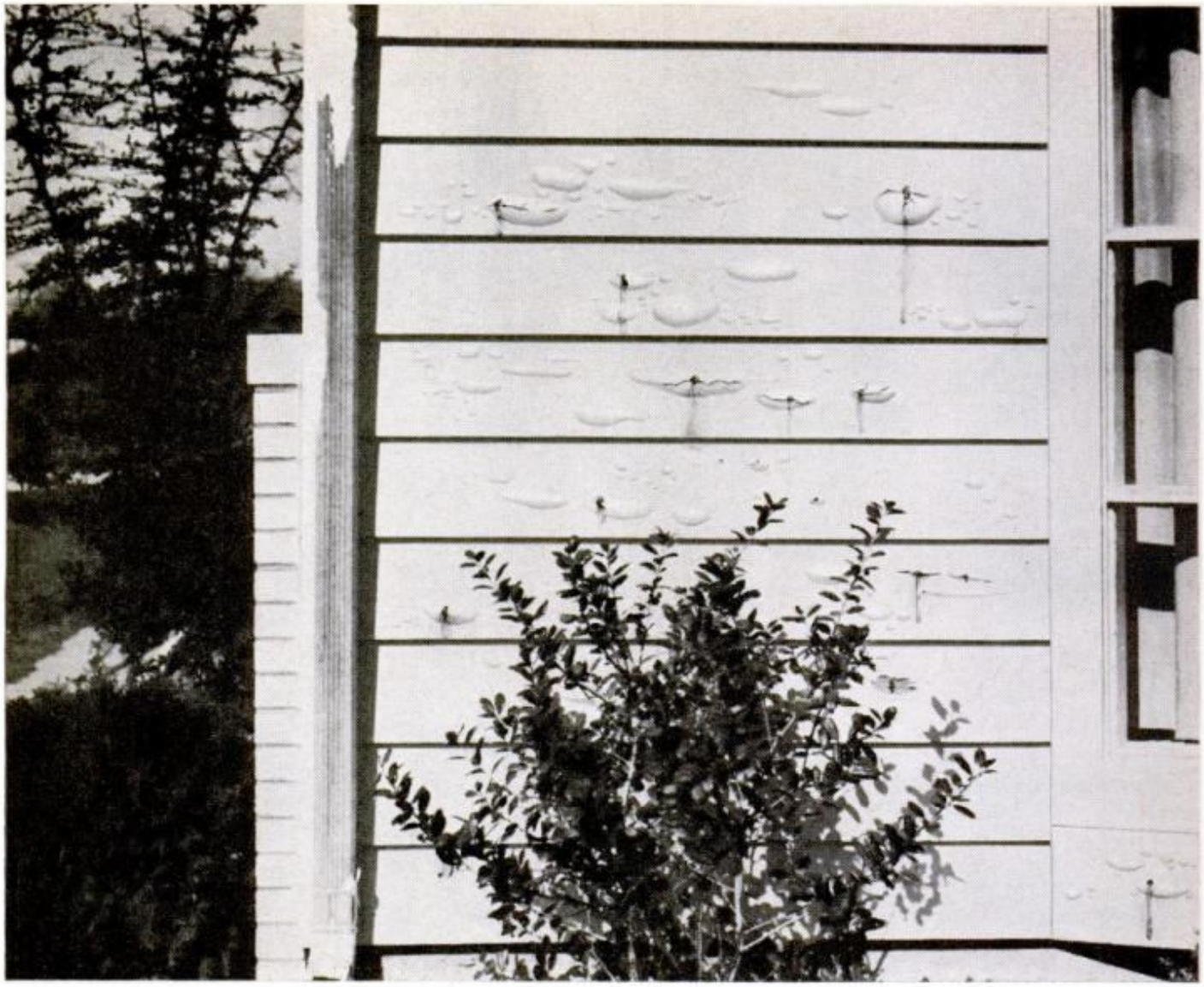

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Balls O'Fire

(Continued from page 208)

With the aid of Geological Survey topographic maps, Dept. of Agriculture aerial photographs, the compass, and the auto mileage indicator, we found the road across the valley, some 3⅓ direct miles from the bend in Spooklight road. Then with Prideaux back at the scope, we verified the road with two-way citizen band walkie-talkies. The road wasn't steep at all—simply a gentle rise that looked like a hill through the scope.

But there was little traffic here—hardly enough to account for the frequency of lights making up Spooklight. So I drove further. At six miles I abandoned the radio; the distance was too great.

Mystery Solved?

Finally, 10 miles from Spooky's shack, I came upon busy US 66, shooting straight to the west in a direct line with Spooklight Road, but slightly lower (Spooklight Road elevation varies from 895 ft. to 1067; U.S. 66 from 813 to 882.)

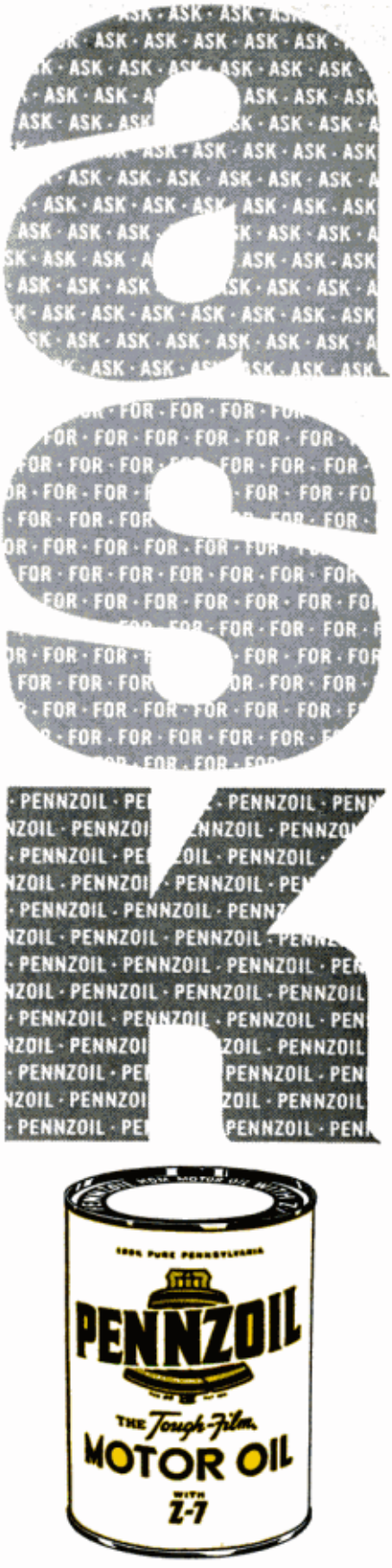
It all tallied. From Spooky's shack you look across 15 miles and see cars coming toward you for four miles in as many minutes. But I wanted more evidence.

Early next morning, just before dawn, we put colored cellophane over the headlights, and following a carefully arranged timetable, I drove eastward on the critical section of US 66, blinking my lights as I went. Prideaux, located on Spooklight Road, spotted every blink.

Later, the Oklahoma Dept. of Highways gave me automobile density figures for a typical Thursday. From 3 a.m. to 4:00, 33 vehicles pass a given point near Quapaw —a figure close to my sample count.

Now that Spooklight's source has been found, have we ruined everything? Not at all. In the first place, even without a mystery the light is a remarkable thing, with all the critical factors that must come into focus: a long, narrow road edged with trees that exclude outside light, a road perfectly aligned with another road across a dozen miles of emptiness, yet at a slightly higher elevation, and a line-of-sight close enough to the moist ground for the effect of "heat waves"—layers of varying-temperature air—which accounts for the shimmering and the peculiar golden hue.

And in the second place, the people who live around there aren't going to believe the explanation anyway. Said Spooky with a shrug when I told him what I had found: "Maybe so. But explain the fact that the light was seen in 1886. No US 66 then. No motor cars, either." ★ ★ ★



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Bag It with a Bow

(Continued from page 109)

portant to the bowhunter. Second is the amazing visual faculty for detecting objects in motion. These two, combined with a well developed sense of hearing, establish a protective screen about deer at all times that extends well beyond the reasonable range of the bow and arrow and is difficult to penetrate.

The bow and arrow as a hunting weapon has three weaknesses. Most important is the short range of the weapon which makes it necessary to approach well within the protective screen of the deer to obtain a reasonable shot. Second is the exposed position necessary to make a successful shot plus the fact that it is necessary to create considerable motion in shooting. Finally, the "twang" of the bowstring travels faster than the arrow and affords the deer time to move if he recognizes danger in the sound.

Hunter Must Be Invisible

In stalking deer with the bow, the natural instincts of the deer and the inherent weaknesses of the bow create a chain of never-ending problems. The still hunter or stalker must locate undisturbed deer, penetrate their natural instinctive barriers and, at close range and sometimes in plain view, make considerable movement without being seen or heard. Impossible? No, it can be done by those who will take the time to learn the ancient art of stalking.

A smart hunter begins planning his hunt before the season opens. He visits the intended hunting area, looking for deer trails linking feeding areas, drinking places, shelter areas and bedding spots. Research on the favorite foods and cover is also a prerequisite.

Go into your hunting grounds against the wind if you can. Remember that air flows up the slopes when it is warm and into low places during the cool hours. Since the best times for stalking are in early mornings and late afternoons (when the game itself is on the move) stick to high ground most of the time. Always move against or quartering into the wind. Rarely can deer be approached downwind to within arrow range.

These important rules used by successful stalkers stand out: (1) Never step on anything you can step over, (2) Take three steps and stop, and (3) Train your eyes to see detail. The first rule will aid in noiseless approach. The second gives you the advantage of seeing the animal before it sees you. The third allows you to spot the animal even in dense cover. Consistent success in stalking is absolutely dependent upon seeing the game before it sees you.

Don't look in open spots for deer. Look at small openings between trees and through brush. Try to single out a part of the animal; maybe his ears, his head, legs or rump and don't make the mistake of only watching ahead. Allow your eyes to rove back and forth, over every bit of cover. And don't just look—SEE what you are looking at. Look for patches of color out of place in their surroundings and be alert to any movements, no matter how small. A flick of an ear or a movement of the tail may focus your attention on a spot and suddenly the entire outline of the animal will take shape. Look back once in a while. Deer are crafty and sometimes hide as you walk by and then sneak out behind you.

Thick brush may cause a stalker to make a wide detour or to give up the stalk entirely. Dry leaves, dry limbs or twigs, and gravel are murder. There are no shortcuts to a successful stalk. Once you lose sight of your quarry as you begin to stalk, you must always assume the animal is still there. The temptation to hurry must be curbed. Use the same timing as a feeding animal. If you move with a steady gait, any animal hearing you will at once become suspicious and alert. Seldom cover more than a mile in an hour, and a half mile is better. Never relax vigilance for a moment. Get down on hands and knees so you can see under tree limbs and take advantage of shorter and usually denser cover. A bowhunter, like a bobcat, should use every suitable particle of cover, no matter how scant. It helps break up that telltale silhouette.

Placement of the foot is one of the most important details in stalking. Short steps are favored. Long steps can cause loss of balance if you have to "freeze" while taking a step. Moccasins or tennis shoes in dry weather and rubber-bottomed, leather-topped "swampers" for damp going are ideal for stalking. Trousers must be of soft material that will not rustle. Loose objects allowed to jingle in pockets are out. Extra equipment should be securely strapped to your body. A soft arrow plate on your bow and silencers on the bowstring are "musts." A camouflage suit, or at least clothing of dull, neutral colors is a big help.

Get Out in the Rain

Don't stay in camp during wet or stormy weather. Deer may often be seen calmly feeding during a downpour. Such days provide excellent opportunities for a silent approach because the deer has to rely chiefly on sight for protection and this is sometimes dimmed by raindrops

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on its eyelashes. I'll never forget the rainy Sunday morning, when the water dripping off the trees into the leaves covered any slight noise of my progress, that I worked close enough to a slowly feeding deer to slap her on the rump with the end of my bow. Other stalks have culminated with kills but none gave me the pleasure that I felt that morning.

I have found the hour after dawn to be the best time of all for stalking deer. After feeding undisturbed most of the night, they are less wary and are on the move toward bedding grounds, feeding slowly as they go, keeping their heads down more than usual. Another trick to remember is that a feeding deer usually switches his tail just before raising his head. So, if you are trying to close the gap on a feeding deer, watch his tail and "freeze" when it moves. Once a stalk is begun, always keep a close watch for other deer that might be standing unnoticed in the vicinity. I've lost several chances at deer because one I didn't see warned the one I was after. If a deer has already discovered you before you are ready—but is within range for a shot—slowly and with as nearly imperceptible movements as possible, work yourself into a shooting position, draw and shoot. If you don't, it is most probable that you won't get a shot at that particular deer.

If you think that stalking sounds like tough work, you're absolutely right. It is tough, both mentally and physically, and takes a different attitude than is usually brought to hunting. You will develop patience. You will use muscles you didn't know existed. Your mouth will become dry. You will sweat and silently curse, but you can never relax.

Yet, when at last you've made a stalk pay off, you will know beyond doubt why this is called hunting's greatest thrill. To best a big game animal in its own habitat, using the means which are inborn in the animal, yet have to be learned by man, is beyond compare in the world of sport.

Where to Aim

Usually, in the excitement of being close to game, there is an impulsive urge to just shoot at the animal. This will not put meat in the pot. A definite aiming spot must be picked. This is very hard to do. It takes considerable will power and usually some experience to curb this desire to shoot quickly at the whole animal. Pick one tiny spot on the animal and concentrate on that spot, then let fly. Make

(Please turn to page 214)

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Bag It with a Bow

(Continued from page 213)

your first shot count . . . you don't usually get a second.

A shot entering through the ribs close to the shoulder will hit the heart or the lungs. Hits from the rear that enter behind the ribs and go forward through the diaphragm and into the chest cavity are deadly. Also effective are the hits through the rear quarters from either side or back. Try to hit low rather than high on the animal.

Once an animal is hit, watch its line of flight. Then remain quietly where you are for at least 30 to 45 minutes. If you do not pursue game, it will usually lie down in the first available cover to die.

Bird-Hunting Tips

Hunting birds such as pheasant with the bow and arrow offers a special challenge and great satisfaction when success is achieved.

Shooting birds in flight with an arrow may seem like a matter of pure luck, but with practice you can become quite proficient.

The best method of practice is to shoot at corrugated cardboard discs about 10 to 12 inches in diameter. These discs are tossed into the air by a companion at about 25 to 30 feet distance from the shooter. Arrows with blunt heads are usually used for this practice. Flu-flu fletching on the arrow helps greatly by reducing the range of the arrow to speed up the retrieves. The discs should be fairly heavy, made by gluing several pieces of corrugated material together. About 1" is a good thickness. The discs are spun up by the edge so that the flat surface is toward the shooter. A black bullseye about 2 inches in diameter painted in center of the disc helps greatly in aiming. Always pick an open spot such as a field or meadow for practice, where the chances of a stray arrow hitting a building or person are nil.

This type of shooting is actually easier than it appears. The secret is timing. The arrow should be drawn and released just as the disc reaches the peak of its rise and pauses slightly before starting to fall. Once an archer learns to time his draw and release in this manner he can hit discs regularly. And, in shooting at birds which rise in front of him, particularly on straightaway shots, this technique will pay off.

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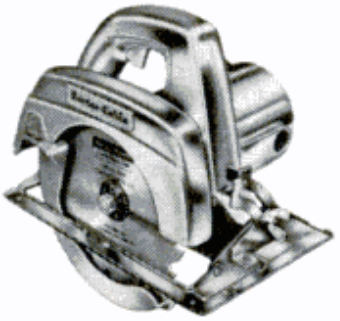

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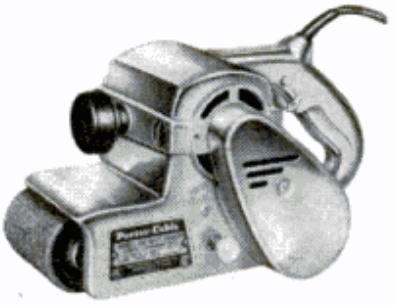

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pheasants are perhaps the most frequently encountered. Just as with the shotgun, an archer must lead his quarry in order to connect. Practice for estimating such leads can again be accomplished with the corrugated discs. Two archers again take turns. One kneels behind a large tree, bank, or other cover and rolls the disc out one at a time, preferably down a slope or incline. Discs should roll past the shooter at a distance of 20 or 25 yards. Learning lead is considerably harder than hitting the airborne discs, but with enough practice one can become fairly proficient at it—enough so that occasional hits on birds can be made.

No special bow is needed. The archer's regular hunting or field bow is fine. Some archers use blunt arrowheads for the actual hunting, but a majority prefer to use regular broadheads. Flu-flu fletching on the hunting arrow is, again, a big help.

Whether hunting for birds, rabbit, deer, or big bear, the thrill of bowhunting is a unique one. You tend to meet the animal more nearly on his own ground. Your effective kill range is much shorter, so you must get nearer the target. There is no thrill as great as effectively stalking an animal in his own environment and winning the contest with a good clean shot.★★★

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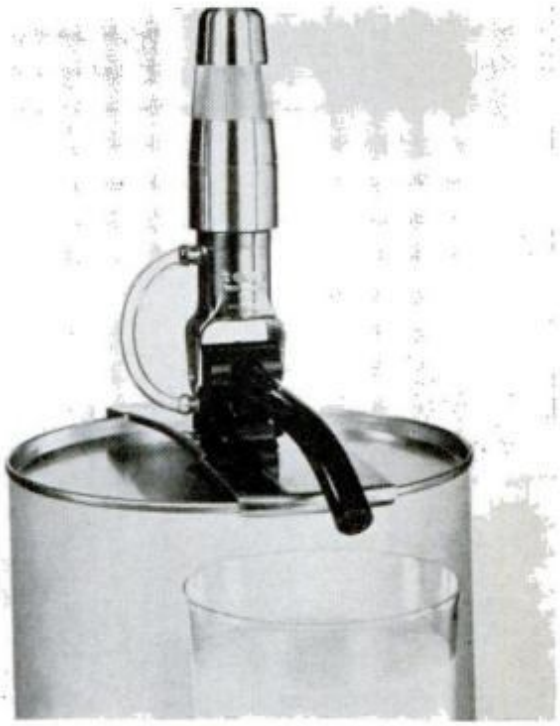

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Stamping Out Firebugs

(Continued from page 102)

nearby state land in an aircraft, swung into position overhead and spotted the youths. Keeping them constantly in sight, he called forest authorities and directed them to his plane. They found one of the criminals, completely frustrated, with his face buried in the leaves when they arrived, the plane still circling overhead.

Vanity Is Their Downfall

Throughout the country, however, the pyromaniac and the vandal seem to be taking to the woods. Since their motives are obscure, their apprehension is correspondingly difficult. In the true firebug's case, his pleasure at the sight of flames may be akin to a sexual sensation according to psychologists. The vandal may be seeking a sense of importance which he finds in newspaper accounts of his mischief. But in both cases there is a built-in weakness which a sleuth exploits: vanity.

Firebugs often hang around their fires, once started, and actually join in fighting the blaze. Thus fire detectives in the forest as well as the city make a point of mingling with any crowd which gathers and have frequently found suspects here. The rapt expression of a pyromaniac watching flames betrays him; vandals are usually caught when their boasts are picked up by an alert citizen. More than 50 percent of forest fires are reported by private citizens and probably an equal percentage of fire cases are solved through their help, which is the best argument for making information about the methods and characteristics of criminals available.

The one thing which foresters are reluctant to discuss even with a reporter is the exact nature of the incendiary devices used by the firebug. Publications which have described—or even mentioned—these gadgets have been censured.

"Why should we give the nut who has a tendency in this direction any ideas about how to start fires?" asked one investigator. "These people may be unbalanced, but they're already clever enough."

But the basic tools are already well known to incendiaries. They range from such simple things as a candle, which may burn exactly an inch an hour and thus give the culprit a carefully calculated period in which to get away, to complex "sets" triggered by alarm clocks and employing chemicals as fierce burning agents. Candles can be set in the midst of some ignitable fuel—the novice may use gasoline and get burned himself when the fumes ignite, while the pro sticks to less volatile kerosene. The scent of any such fluid near a fire is a sure giveaway.

The more elaborate devices, since they are not reliable, are often used by beginners or one-time incendiaries. Alarm clocks are rigged for a fuse by tying matches to the bell hammer; they ignite as they are dragged across an abrasive surface when the alarm is activated. Magnifying glasses have also been placed so the rays of the sun would be focused onto a pile of fuel at some particular hour. A real professional may even employ an acid which eats through the wall of its container at a known rate and produces an explosion through its subsequent contact with another chemical. Phosphorus and water in certain combinations can also be used to produce fire. To detect such elaborate setups requires the trained eye of an investigator, but anything resembling them should be reported.

Simple Fire-Starters

Simpler tools are more common and easily recognized. A fuse used widely is a cigaret tied to a book of matches so that they will ignite when the tobacco burns close to them. This gives nearly ten minutes for a getaway. In the southern forests a favorite tool is a length of rope, soaked in kerosene. Burning, these effective fire bombs have been thrown from car windows in nearly every southern state and made large forest blazes certain. In Idaho, 39 similarly simple devices were planted during a recent fire season, of which 28 succeeded in their purpose. All of them, investigators found, were all work of one man. Thus even with rudimentary devices, a single firebug can easily set a dry countryside afire.

The importance of public familiarity with these practices was illustrated recently in Oregon. An alert lady living near a fire site recalled something being thrown from a passing car. She searched through the ashes until she found it, then covered the evidence with a hub cap until investigators could examine it. This evidence wasn't much—the charred remnants of a cigaret-match device, tied together with a colored thread. But the investigators found a neighbor who had given such thread to two men. They were identified and arrested; when confronted with the evidence, they confessed.

Investigators who turn up such evidence can take it to police crime laboratories for analysis. Some states, like California, have their own labs, and all law enforcement agencies are offered the use of the FBI facilities. Charred remnants are subjected here to tests by spectrograph, ultraviolet rays, and other processes which identify

(Please turn to page 218)

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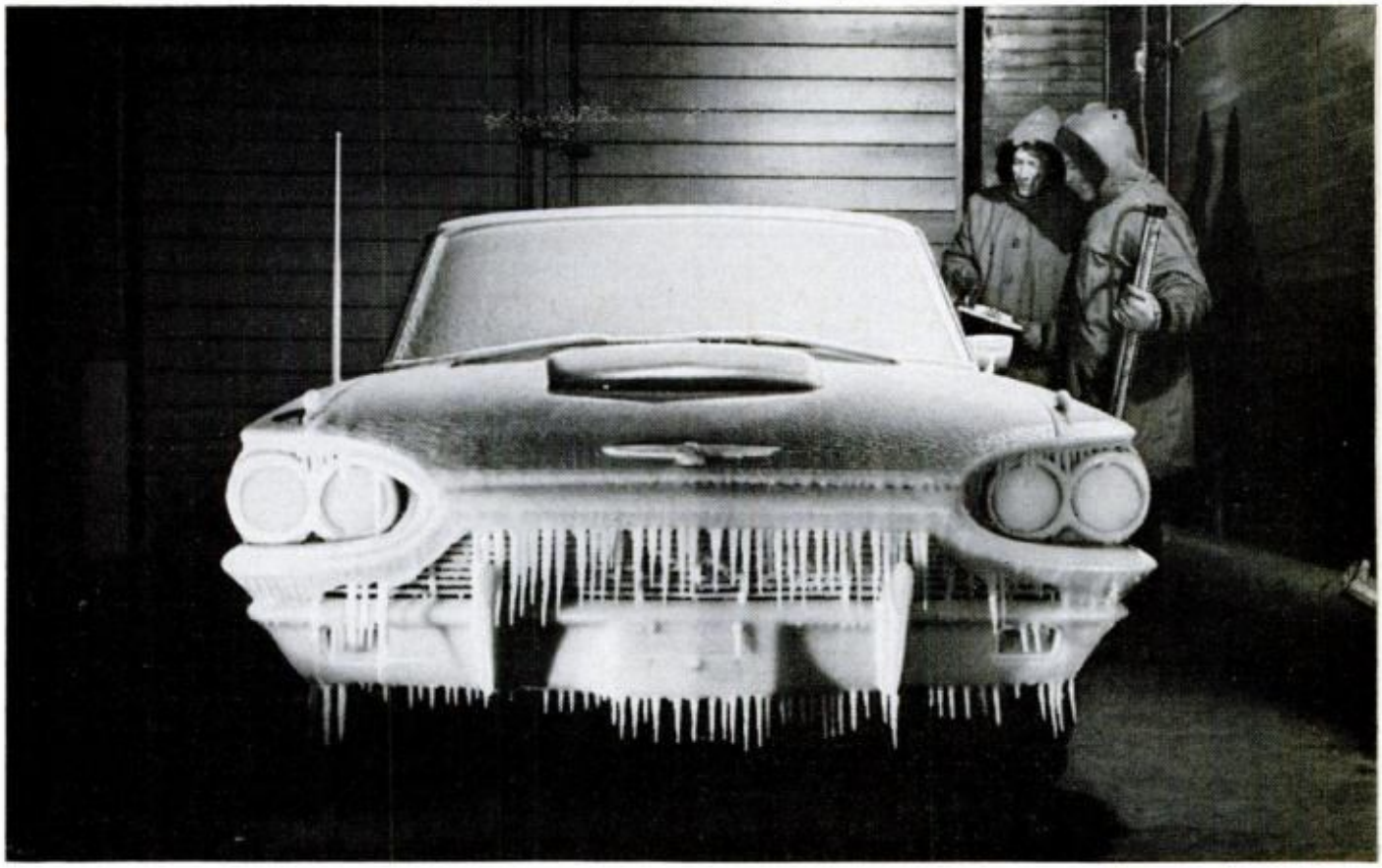

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Stamping Out Firebugs

(Continued from page 216)

the original character of these materials.

Nevertheless, the problem of just what to do with incendiaries once they are caught is often a frustrating one. Some culprits are otherwise reputable citizens, guilty mainly of indifference or ignorance. Foresters can press a civil suit to recover the costs of fire suppression and damages, but these may be far beyond the ordinary person's ability to pay. When the fire is maliciously set, a criminal charge is usually placed against the guilty.

Courts Are Lenient

State courts, however, are notoriously lenient when it comes to forest burning. Arson, a more serious charge, must include the burning of a dwelling, although lives can be easily lost in a forest blaze. The person who set the Angeles Forest fire that killed two persons and injured 50 others served seven months of a two-year sentence. In Mississippi recently, foresters managed to send their first incendiary to jail for burning a national forest. In other southern states the average fine for this offense is less than $10.

Pyromaniacs can plead that they were driven to their crime by an overwhelming compulsion, which may be true, but this does not relieve them of legal responsibility for their acts. The fact is that these people almost invariably plan their fires well in advance and go to considerable pains to cover their tracks, which hardly qualifies as an impulsive act. Despite the advice of investigators, incendiaries are rarely given psychiatric tests or treatment. Yet studies have shown that fire has a fascination for a large percentage of the populace, which may reach overwhelming proportions in more instances than is now suspected. At least one of every five adults, studies show, have set fire to something large just to watch it burn.

Meanwhile, the forest burner is given repeated chances to ply his hobby. A man arrested in 1935 for setting forest fires in New Jersey was again apprehended in 1942. Released for the second time, he moved to New Hampshire and was caught five years later touching off another forest.

"Our main purpose now," commented a Utah forester, "is mainly to remind everyone who uses the woods that somebody *does* care what goes on there as regards fire. We aren't snooping, but we are determined to see that people start living up to their responsibilities here." ★★★

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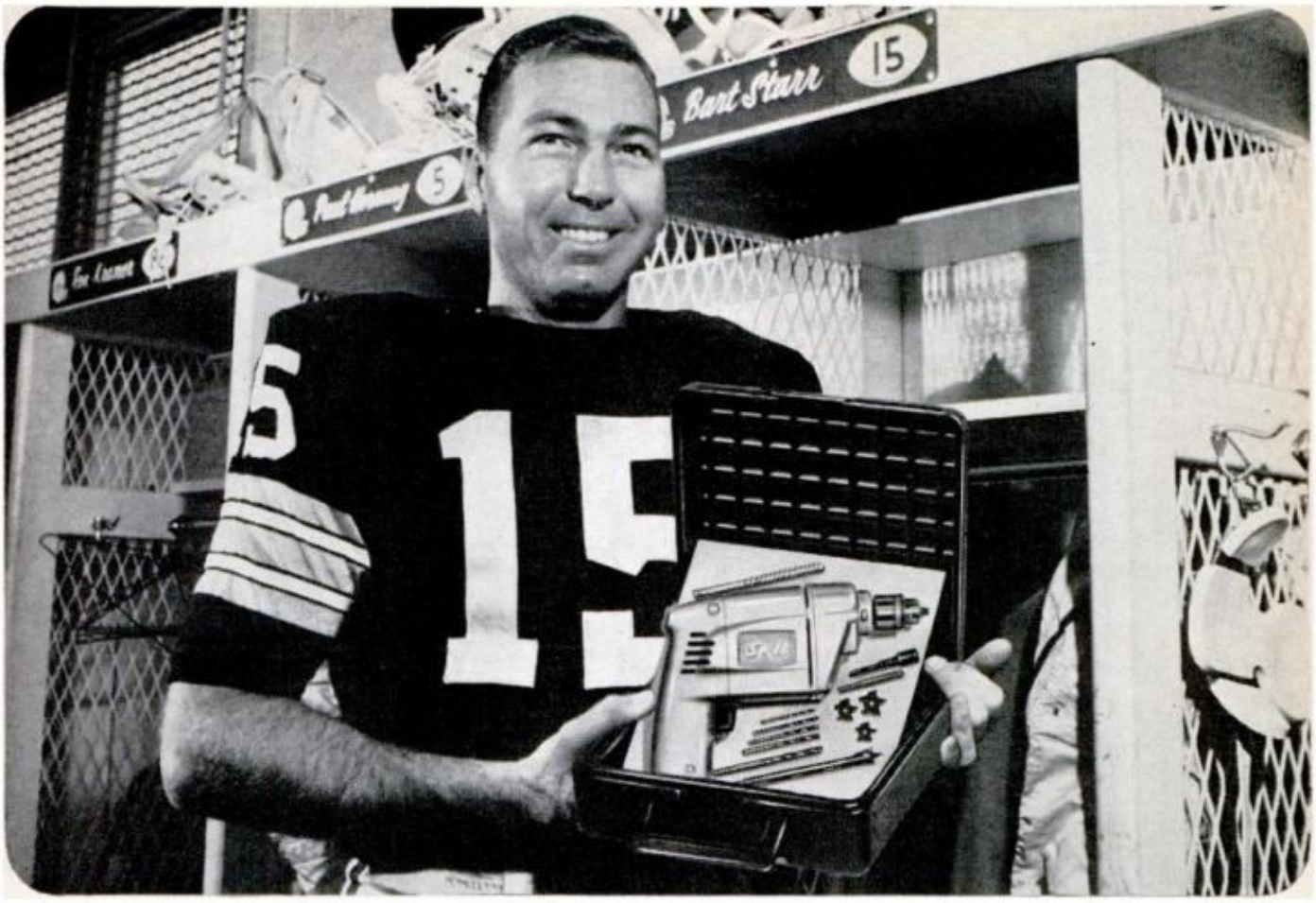

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I Hit the Ground at 150 MPH

(Continued from page 105)

leg over the engine, let go of the handlebars and, with plenty of help from the wind, flung myself off. *Bloody Mary* roared on, unswerving, and disappeared into the woods.

I had survived a similar incident with *Bloody Mary I* without serious injury, but this time I was certain I had pushed my luck too far. I must have hit the ground at well over 150 mph.

I landed flat on my rear and skipped along with my legs stretched forward, like a bobsled rider, for what seemed an eternity. Then I slid down until I was bumping along flat on my back. After I had slowed down considerably, my head and feet swapped ends and I did a series of violent flips. I rolled to a halt, still conscious, and immediately stood up and checked myself for injuries. Except for holes burned in my leathers in a couple of embarrassing places, and some burned skin, I found no damage. Hours later I realized how bruised and burned I was.

Like a Twister

By the time the ambulance and my pit crew reached the scene, I had walked the few remaining feet to the woods and found the path that Mary had scythed through the woods. She bowled over everything in her path, including several four-inch-thick trees. It looked like the wake from a miniature twister.

We found the battered remains about 150 feet into the undergrowth. The wheels and frame had sheared off, along with all engine accessories. All that remained was a bare engine that had been pounded so badly that I'd be afraid to use a single part of it again. Later, disassembling it for inspection, I found it full of leaf particles. It was still running as it tumbled through the brush, sucking in leaves.

My wife was glad to see the last of *Bloody Mary II*. Maybe now, she said, I'd settle down with a nice, quiet mechanic's job. But within two weeks I was hard at work in my Ithaca, Mich., machine shop, building a new *Bloody Mary*.

I've been fooling around with outlandishly powered vehicles for years. I built my first V8 bike on a whim, just because I wanted something spectacular. My first time out, I laid a smoke screen from one end of the strip to the other. The crowd really woke up. After the run, the track manager offered to pay me for a return appearance the following week, and suddenly I was the world's only professional two-wheel dragster driver. Since then I've earned a good living driving all over the country.

Besides the bikes, I've built two 3000-hp. Allison-engined stock cars. With all this experience, I didn't take long to build *Bloody Mary III*. I started with a hopped-up 327-cu.-in. Chevy fuel-injected V8. which I slung under a tubular chrome-molybdenum frame similar in design to those of my earlier bikes, with the engine as an integral part. I used the same type of Triumph front fork, the same type suspension and wheels. The rear wheel takes a big sports-car tire. I made my own rear brake lining from a brass-asbestos steam-shovel clutch plate. But I knew that no brakes could possibly stall 600 horses running wild, so this time I installed a fuel shutoff switch. I tried a helicopter torque converter for a transmission, then went back to direct drive.

No Tires for Two-Wheelers

All the *Bloody Marys* had power to burn; the only thing hurting their times was lack of tire traction. No one has ever developed a tire for two-wheel dragsters, and probably no one ever will. I go through plenty of tires—but not enough for a company to spend money developing a tire just for me. *Bloody Mary* is the only two-wheel dragster running regularly; there are a couple of others around, but they never seem to get off the show floors.

Speaking of tires, I get only three-quarters of a mile out of a tire. This was a big expense until I started turning them in on road-hazard warranty. Now the local tire dealers no longer close up shop when they see me coming; I have a deal with Firestone. They give me the best sports-car tires made, but I still strip them of tread after 30 seconds of running time. I *could* squeeze another run or two out of them, but a tire failure at speeds up to 160 mph would probably mean curtains for me.

Bloody Mary III is one of the biggest attractions around—on AHRA (American Hot Rod Assn.) and the outlaw (unaffiliated) strips. NHRA (National Hot Rod Assn.) says that the bike is actually a two-wheel dragster and must have a roll bar and a seat belt. On a two-wheeler, this is suicide. The only protection a man on a 'cycle needs is quick reflexes, leathers, a helmet and a prayer. If you can't put your faith in these, you'd best never throw a leg across a two-wheeler.

Now I'm working on an encore—a 1200-hp., twin-V8-engined motorcycle. Maybe it won't go any faster than number III, but you can bet a lot of eyes will widen when *Bloody Mary IV* lets go with all 16 barrels. ★★★

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hit the high road to fun on a new Harley-Davidson!

the greatest line going from 50 cc. to 1200 cc. Starting at about $225.

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3. Sportster H, 900 cc.
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5. Bobcat, 175 cc.
6. Sportster CH, 900 cc.
7. M-50, 50 cc.
8. M-50 Sport, 50 cc.

the fun wheels are here! Harley-Davidson for 1966, the greatest line glowing and going under the sun. ■ And one of these gleaming beauties is just for you. So name your kicks. Lightweight fun on the nifty M-50 . . . or the hot new M-50 Sport. The cheetah-quickness of a Sprint. The smooth Electra-Glide ride. The go-go power of a Sportster. Or that brand new tiger we call Bobcat. ■ You name your brand of fun, Harley-Davidson's the brand that's got it. 18 great new models for fun and competition. ■ And every model has that solid quality that gives you confidence. Go Harley-Davidson, the people who wrote the book on two-wheeled quality. See your dealer for the go-go line now.

HARLEY-DAVIDSON

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Parker

is making grass GREENER these days

Parker is making grass greener these days with the Thatch-O-Matic Power Rake. Here's an easy way to remove thatch (matted dead grass imbedded in the turf) that makes lawns brown, ugly. No more arduous hand raking . . . no more damage to living grass. You can rent the Thatch-O-Matic at most Hardware Stores and Garden Centers.

PARKER is keeping grass GREENER these days

After de-thatching your lawn, keep it greener by regularly using a Parker Lawn Sweeper or Vacuum. Unlike the bag-type mower that catches only a portion of the grass clippings as you mow, a Parker Sweeper easily removes practically all of the grass clippings, leaves and other debris; prevents thatch build-up . . . keeps your lawn greener. Manual, trailer and powered sweepers and vacuums are available for rent or sale.

Parker

PARKER SWEEPER CO.

Dept. 344 Box 720 Springfield, Ohio

Checking Out Your Circuits

(Continued from page 181)

So, aside from damaging the meter, you won't even get a reading because that scale won't go high enough.

• *Starter Draw (Current Draw) Test.* This tells you how much current the starter is pulling and, therefore, whether the internal electrical parts of the starter are in good shape. Starter-draw specifications differ from one starter to another, so you have to get the specs before doing the test. If you don't have a manual, a dealer who sells your brand of car may help you out. You need a voltage specification and a maximum amperage draw spec. But he'll know what you mean if you ask for specs for the starter draw test.

Before hooking up the meter, turn the shunt control knob off and the voltmeter selector switch to mid-range. Don't forget to keep the jumper in position on the distributor primary.

Crank the engine and note the exact voltmeter reading. Stop cranking and turn the shunt control knob to the increase side until the voltmeter reads exactly the same as when you cranked the engine.

Crank the engine again and read the ammeter. This tells you the current draw of the starter. If it isn't the same as that specified, something's wrong inside the starter. Take it off the car and have it disassembled and bench-tested at a shop. At that time, you can decide whether it pays to rebuild or replace it. ★★★

Super-Bright Headlights

Sealed beams adapted to fit standard high-beam sockets on automobiles with four-light systems will throw more than 2½ times the amount of light given off by the standard high beams, according to the maker.

The 130,000-candlepower beams have a special pigtail connector that plugs into existing sockets. No alteration is needed. The beams draw only slightly more current than standard beams. Price $9.95 from Warren Automotive, 8149 Keystone Ave., Skokie, Ill. 60076.

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Flash Photography's New Face

TWO NIFTY INNOVATIONS FOR AMATEURS, designed to help make picture-taking foolproof, arrived on the market recently. One involves a tricky automatic "flashcube" that will take four pictures in succession. The other is a wind-up film transport that has been coupled to the flash socket. When the spring motor advances the film, the cube automatically rotates 90° to line up a fresh bulb for the next shot. The flashcube, made by Sylvania Electric, required more than four years to perfect. Six new Instamatics, ranging from an $18 manual-wind model to a $125 rangefinder camera, have been specially designed to accept the flashcube. Two 35-mm flashcube cameras priced at $95 and $115 are also available.—*Bob Berger*

SPRING MOTOR on $29 Model 154, automatically advances film and rotates flashcube after each shot. Flashcubes cost $1.95 for pack of three; have high efficiency

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Bean's Chamois Cloth Shirt

Sueded cotton. Looks and feels like high grade chamois leather. Machine washable and is more durable than wool. Mr. Bean personally uses this shirt on his hunting and fishing trips. Colors: Tan and Bright Red. Sizes: 14½ to 19. Price $5.85 Postpaid. Send for free sample and Free Fall Catalog.

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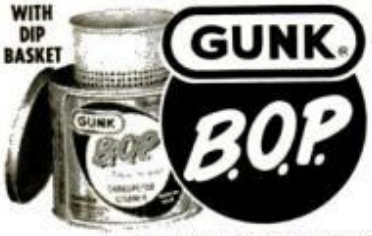

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Home, shop or farm models available . . . all guaranteed 5 years at most hardware, auto and paint supply stores.

SPRAYIT

THOMAS INDUSTRIES INC.
207 E. Broadway, Louisville, Ky. 40202

Great Hobby Corners

(Continued from page 150)

nary decorative corner cabinet, it's actually made to order for the rock hound and the coin and stamp collector. There are shelves galore for displaying a prized collection and the cabinet features a false-door front which lifts up to become a handy worktable.

The sportsman who likes to tie his own flies or load his own shells will find his hobby twice the fun with the "corner" specially designed for his needs. A self-supporting drop lid provides a convenient "workbench" for clamping a fly-tying vise or holding a shot-shell reloader. Glass-covered drawers, plus a slanting backboard, affords display space for carded flies, reels or other gear. ★★★

The Leaner Look

(Continued from page 142)

says he has reduced such nuisances as squeaking floors and stairs. He is also working on adhesive application of Cedar shingles. Possible saving: $21 a square.

One more floor system—this one from the National Oak Flooring Manufacturers. Their system gives a warm, comfortable wood floor over concrete slabs, and eliminates the bother and cost of subflooring. It works this way:

First, 1 by 2s spaced 16 inches apart are laid in a bed of adhesive and nailed to the concrete. Then, the builder lays a polyethylene sheet over the 1 by 2s and nails a second 1 by 2 over each one that's already in place. Finally, after insulating between the 1 by 2s, a carpenter nails wood flooring over the 1 by 2s. This system has been tried successfully in over 200 houses.

Unfortunately, no article on housing research can cover every project now under way. And new projects seem to crop up almost daily. But the time is not far off when you'll see the results of all this research first hand—in the form of better value for your housing dollar.

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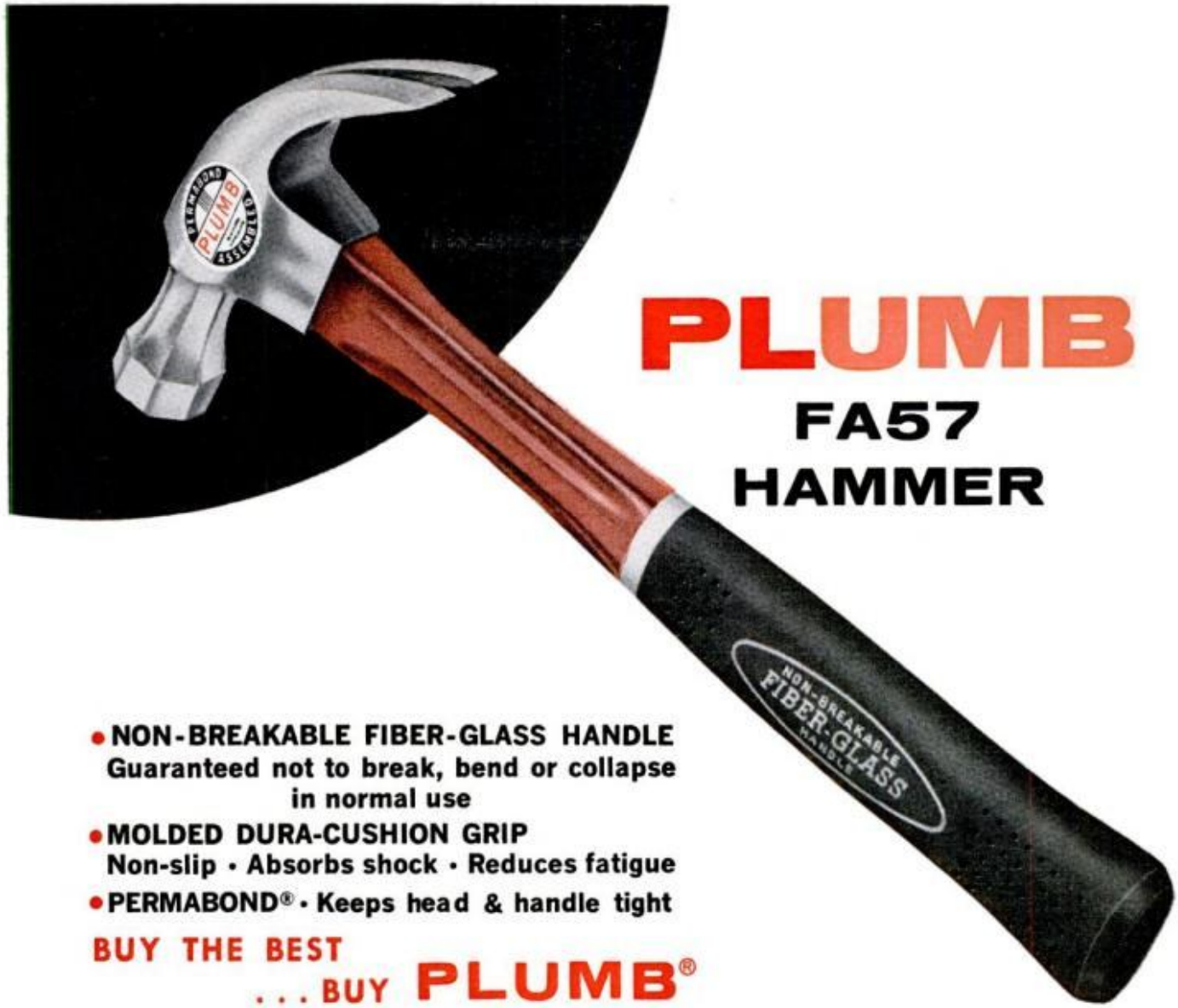

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Bottle-fed like a baby and spanked like a baby if it makes a mistake—that's the kind of electro-chemical computer that may displace the giant electronic brain of today. Air Force scientists are trying to build one. It would have many small cells —modeled after neurons of the human brain—containing iron, acid and gold.

The first two would provide electro-chemical energy. The gold would deposit in dendrites (tree-shaped crystals) connecting the cells in an intricate web of electrical circuits. A series of electrical shocks ("spankings") would change the circuits until they finally behaved like a computer and gave right answers. By one estimate, it would take about a year of spankings to train such a computer.

✔ ✔ ✔

A "staying awake" meter has been developed for the Army. It's being used to measure the effects on the alertness of soldiers of such things as time on duty, distractions, and the like. It may show, for example, that the customary two-hour stretch on guard duty is too long; or that a GI may be able to walk a sentry post for three hours at a time with no bad effects. The device was developed by the National Bureau of Standards.

✔ ✔ ✔

Cabbage cat-naps are something new in the Navy. Vegetable and fruit spoilage on ships at sea has long been a problem and now Navy research people have come up with a technique called total environmental control. Under the process, which calls for the use of nitrogen in an airtight compartment, the produce, which is a living, breathing organism, will be put in a state of suspended animation. In other words, they'll sleep until ready for use.

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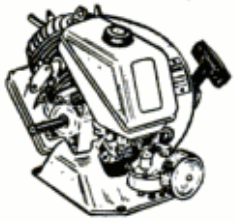
Briggs & Stratton — Clinton New Gas Engine Sale

Never before and perhaps never again—this offer of brand new genuine Clinton and Briggs & Stratton engines including 1 yr. factory warranty *at less than cost*. Perfect power for go-carts, scooters, tractors, mowers, generators, pumps, sprayers, etc. We bailed out 3 big factories who needed cash and the savings are yours while quantities last. *Act fast.*



Clinton 2½ hp. Mdl. 500—Recoil starter Std. ⅝ shaft w. keyway—ready to go. Reg. price $49.50 Special (item 1002)

$29.95

2 for $59.50
6 for ...$176.50

Briggs & Stratton 2 hp. Mdl. 60101 Rope start, std. ⅝ shaft w. keyway. Sturdy 4 cycle power. Regular price $49.80 Special (item 1002)

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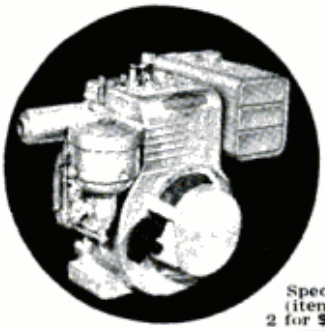
2 for $58.90
6 for $175.50

$69.95 5¾ hp. Briggs & Stratton



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2¾ h.p. Clinton—34.95

Model 400, rugged 4 cycle model. Alum. Block, castiron cylinder Rope start—⅝" std. shaft.
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A big engine with big power. Model 406, 4 cycle, rope start, ¾" std. shaft.
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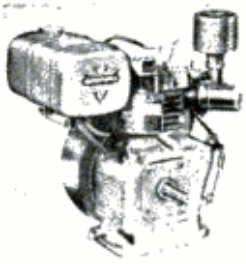

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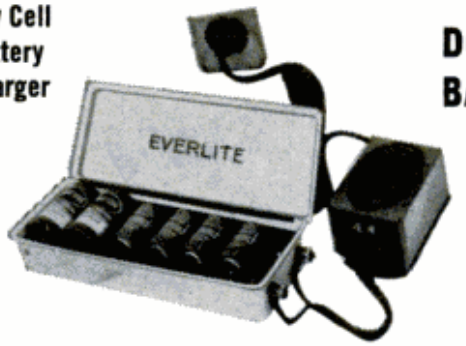

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Model #66 (with car battery booster) **$7.95**
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Southern Customers write Dept. A-965, Box 65, Sarasota, Florida

750 MPH: Here I Come

(Continued from page 92)

inch forged aluminum wheels, and the front tires are 8.00x25s, on 25-inch forged aluminum wheels. The tires have a footprint five and a half inches wide, very thin tread, and an extremely low angle in the fabric restrictor belts. (Ordinary radial ply tires have a belt under the tread, in which the cords run at as little as 20° from the direction of the tire. In land speed record tires that angle is so low the cords are almost continuous) We have the tires to go beyond Mach I.

I've given a lot of thought to the problem of slowing down in a hurry. The course is only about 10 miles long.

SPIRIT OF AMERICA
Specifications

Length 34′ 6″

Max width 85″

Height (less tail) 59″

Wheelbase 200″

Front tread 42″

Rear tread 70″

Suspension: torsion bars, fore and aft

Dry weight 8000 lbs

Powerplant J-79 turbojet

Fuel capacity 100 gallons

Systems: include data recording system for ground loading on tires vs. airspeed

Est. top speed: supersonic

Construction: 1½″ diameter chrome moly tubing truss frame, aluminum skin. Fiberglass air duct and fuel tanks. Tail is foam-filled fiberglass skin over aluminum panel.

Last fall, in my last run in the original "Spirit," I was doing 562 mph at the end of the measured mile, and I yanked the drag chute handle to start slowing down. Nothing happened, so I yanked the emergency chute and still the car didn't slow down. (Both chutes had torn to shreds.)

I stepped on the brake pedal and it went all the way to the floor. The disc brakes weren't working. All I could do was to steer off to the right to gain more distance. The car flashed past the end of the course and onto the rough salt. I saw a phone

(Please turn to page 230)

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**Manufacturer's suggested retail price. Available throughout the United States and Canada.*

TRUE TEMPER®

750 MPH: Here I Come

(Continued from page 228)

pole coming up and couldn't avoid it. The car shattered the pole, splashed through a lot of shallow water, climbed a clay bank and sailed 50 feet through the air. Then it crashed in a deep pool of water. Miraculously, I wasn't hurt.

You can understand why we've given a lot of thought to the braking systems in the new car. We've even considered the thrust reversers that jet airliners use, and the spoiler, used by fighter planes.

I'm going to depend again on drag chutes, this time especially strengthened against high opening shock. If necessary we'll use a reefed chute that "grows with time." The chute is small when it hits the air, then a timer is set off which cuts the reef points, allowing the chute to open full size. This insures a gentler opening without a terrific initial impact.

For final slowing to a stop we are using aircraft-type disc brakes, possibly using liquid nitrogen sprayed as a gas to keep the brake pucks cool.

For personal safety in the first "Spirit" I was strapped in a steel shell contoured to my body, a sort of "100% crash helmet." I'm not using it now because it gives no protection against a new kind of hazard. The chances are that I'd be killed simply by high G forces if the car rolls or spins at high speed. The accelerations would be so great my blood vessels would burst.

I'll wear a crash helmet and padded safety harness, mainly to avoid being slammed around in the cockpit. Even the smoothed salt gets rough at high speed.

My main protection will be the same careful speed build-up that I've used before, checking out every part of the car and the way it handles. The next run will be about 50 mph faster if no trouble develops, finally building up to the fastest speed. This method allows us to detect, analyze and correct any trouble before it becomes dangerous.

No one ever dreamed of a supersonic automobile a few years ago. Yet I expect the "Spirit" to become one. If troubles develop (and delays often do occur in projects like this) I'll try all over again.

One thing is certain. Some one, some day, will drive a car at Mach I or faster. My group of consultant-friends are as qualified as any group in the world for designing and building such a car. We are sure that the new "Spirit" can do it.

This is not merely for the sake of going fast. As Walt Sheehan points out, this is really a research project. We may get all sorts of information needed for the high speed transportation of tomorrow. ★★★

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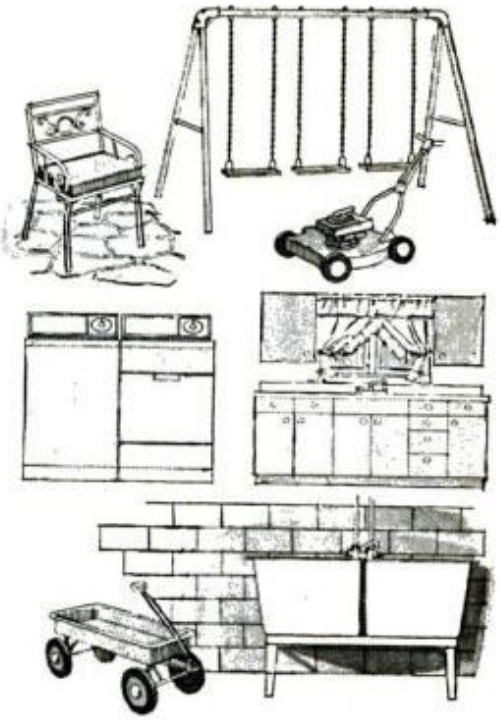

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Sizzling Enigmas

(Continued from page 97)

ates relatively weak radio waves. If the sun was as far from earth as the nearest star, our present day telescopes could not pick up its signals.

If not stars, what then were 3C 273 and 3C 48? One thing was certain — they weren't freaks or isolated cases. They were soon joined by 3C 147, 3C 254, 3C 245 and others. At this writing, about 45 such objects have been identified. Each has been pinpointed by radio and optical telescopes.

Spectrograms Are Confusing

But getting a photo of a celestial body is only the prelude to a detailed study of its spectrum. Close analysis of the light it radiates can provide clues to the object's composition, temperature and distance. Spectrographic studies of the new finds, which were particularly strong in ultraviolet light, only served to deepen the mystery.

Astronomer Jesse L. Greenstein of the California Institute of Technology made an extensive study of 3C 48. The lines of its spectrum, he reported, "fell into no simple pattern and did not correspond with those observed in other stars or supernovas, nor with the prominent lines of bright nebulae."

Two years passed before another Caltech scientist, Maarten Schmidt, got the investigation back on the track. In puzzling over spectrograms of 3C 273, it occurred to him that the key lines might make sense if considered in terms of the "red shift"—a yardstick used by astronomers to measure velocity and distance.

An object at rest may give off a certain light, say, blue. But the faster it moves *away* from the observer—at astronomical speeds, of course—the more the wave lengths of the light become lengthened and move toward the red part of the light spectrum. The "blue" object now appears red. (A similar thing happens with sound waves. The pitch of a train whistle drops, the sound waves lengthening, as the train speeds away from you.)

Schmidt was surprised to find that 3C 273 had a red shift of 16 percent. If correct, that meant that 273 certainly was no star in our own galaxy—but an object in the far reaches of space flying away from earth at a speed of about 30,000 miles per second!

Red Shift as Indicator

The red shift can be translated into terms of speed—the bigger the shift, the closer the object is to the speed of light. The red shift of several of the other mysterious objects—now dubbed quasars—

(Please turn to page 234)

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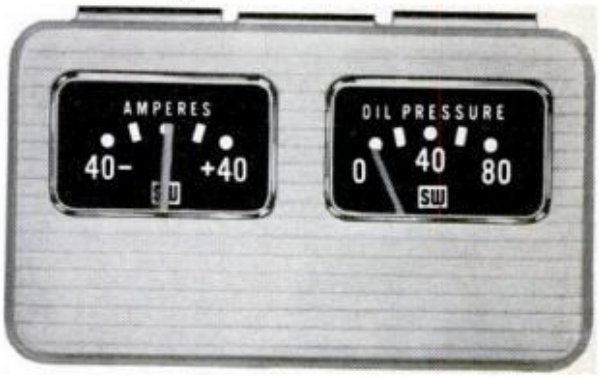

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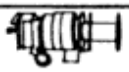

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Sizzling Enigmas

(Continued from page 232)

were studied. Schmidt came up with some amazing speeds: 3C 147—76,000 miles per second; 3C 254—93,000; 3C 245—113,000. The fastest of all was 3C 9 with an estimated speed of 149,000 miles per second, 80 percent of the speed of light!

Red shift also indicates distance. Observation shows that the universe is constantly expanding. And in an expanding universe, those objects moving the fastest must also be farthest away.

Calculations indicate the 3C 273, for example, is at a distance of about two billion light-years and 3C 48 four billion light-years. That would make 3C 9 the most distant object ever detected—just how distant is impossible for scientists to determine. But for the quasars to be visible at such distances indicates they are 100 times brighter than a galaxy containing billions of stars.

Astronomers say that the fanastic distances involved make it next to impossible for estimates to be accurate. A light-year is the distance that light travels in one year; since it travels at 186,000 miles per second, it covers six million million miles in a year. Multiply that by, say, four billion light-years (for 3C 48), and you have an incomprehensible distance. It's small wonder that Maarten Schmidt has commented: "We have had to throw our yardsticks out the window."

But peering that far out into space means that you're also looking way back in time. The light and radio waves now being received from the quasars started their journeys billions of years ago, before the birth of the sun and the earth. The objects themselves probably no longer exist, having disappeared in fiery deaths.

Back Almost to Origin

Sandage thinks that it may be possible for the big Palomar telescope to look back 93 percent of the time since the very beginning (if there was one) of the universe. The rate at which the universe is expanding suggests that it was born at a single point some 13 billion years ago. And when 3C 9 existed, according to Schmidt, the universe was only a third as large as it is now.

There are two main theories of the universe—the "big bang" and the "steady state"—and it's thought that continued study of the quasars will throw light on them. Both are based on the observed expansion of the universe.

The big bang theory postulates that the universe began with a huge explosion of

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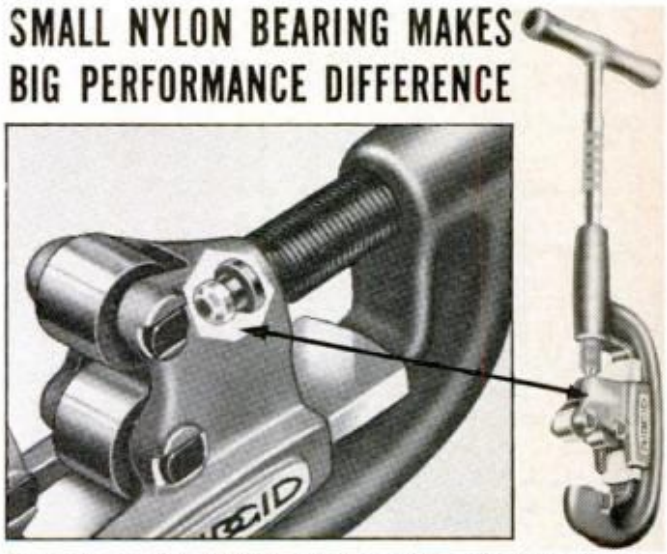

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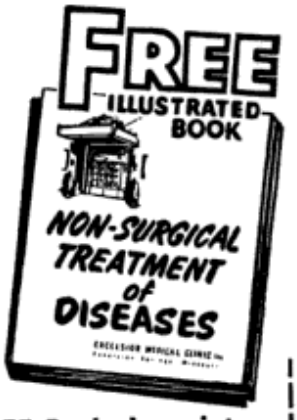

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Sizzling Enigmas

(Continued from page 234)

an original mass. It has been evolving and expanding ever since, like a tremendous cloud of gas, with stars and galaxies condensing and forming. Those objects that acquired the greatest velocity at the outset are the most distant. (Where the original mass came from is, of course, the big question.)

The steady state theory holds that the universe is eternal, with no beginning or end. As it expands, with objects moving farther and farther apart, the voids are spontaneously filled by new matter.

The more we learn about quasars and other distant objects, the more we'll know about the universe as it was very long ago. If we find that it was quite different from its present state, then we can eliminate the steady state theory.

Strange Blue Galaxies

The probing of the far reaches of space has turned up a "relative" of the quasar. Last June, Allan Sandage announced the identification of what he called "quasi-stellar blue galaxies." He said that they resembled stars, traveled at great speeds and emitted large amounts of blue light. Unlike quasars, however, they do not send out radio waves. It's thought that they outnumber quasars by 500 to 1 and may represent a later evolutionary step.

Painstaking research also has also brought other unusual aspects of the quasars to light. They pulsate in their energy output. Checking old photographic plates, scientists found that one quasar's visible radiation pulsated in a regular, 13-year cycle. Another was found to have tripled its output within two years. Others were found to fluctuate in radio wave propagation. Studying 3C 273, one observer reported that it showed a 40 percent increase in emission over a three-year period. In two others, he detected sizable decreases.

When Russian astronomers found that one source sent a "flickering" signal every 100 days, one of them announced that they had discovered a supercivilization, that intelligent beings were trying to contact other rational creatures.

Though Western scientists are convinced of the probability of intelligent life existing outside of earth, they quickly discounted the Russian's claim. (Later, even his own colleagues demurred.)

"All that the Russians are saying is that a regular pulse of radio emissions has been discovered," commented a British scientist. "There are many possible explanations, some of them purely in physical terms."

(Please turn to page 238)

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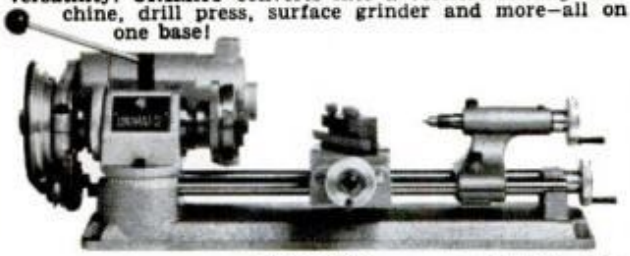

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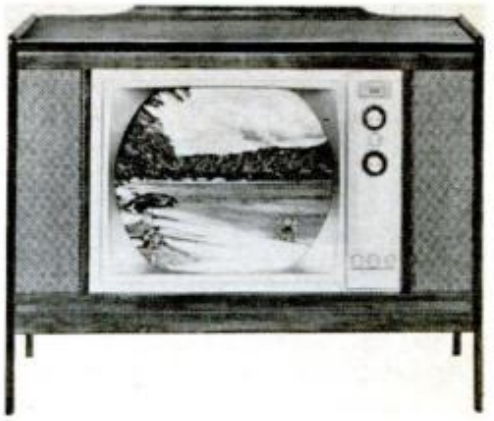

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Sizzling Enigmas

(Continued from page 236)

Scientists at Caltech thought it unlikely for any civilization to be able to control energy equivalent to that of billions of suns.

What quasars are and how they're formed are questions that remain unanswered. How the fantastic amount of energy they pour out can be produced by relatively small objects remains a mystery.

Some scientists think that a quasar may be an early and compact stage in the evolution of a galaxy, the unusual brightness resulting from the explosion of supernovas at the rate of about 100 a year (the usual rate is one explosion every 300 or 400 years).

Other investigators theorize that they are supermassive, pulsating stars energized by nuclear processes. They are enclosed in immense clouds of accelerated electrons and by gas clouds that glow as the star excites them with ultraviolet radiation. After their nuclear fires burn out, they collapse under the weight of their own gravitational forces and disappear from view.

Yet other scientists are of the opinion that none of the known processes in physics can account for the mysterious objects. One of these men is Dr. Herbert Friedman of the Naval Research Laboratory, Washington, D.C. Says Dr. Friedman: "We just do not know how to account for the release of such tremendous energy. What we know about nuclear reactions and effects from annihilation between matter and antimatter doesn't fit. We may be witnessing an entirely new source of energy." ★★★

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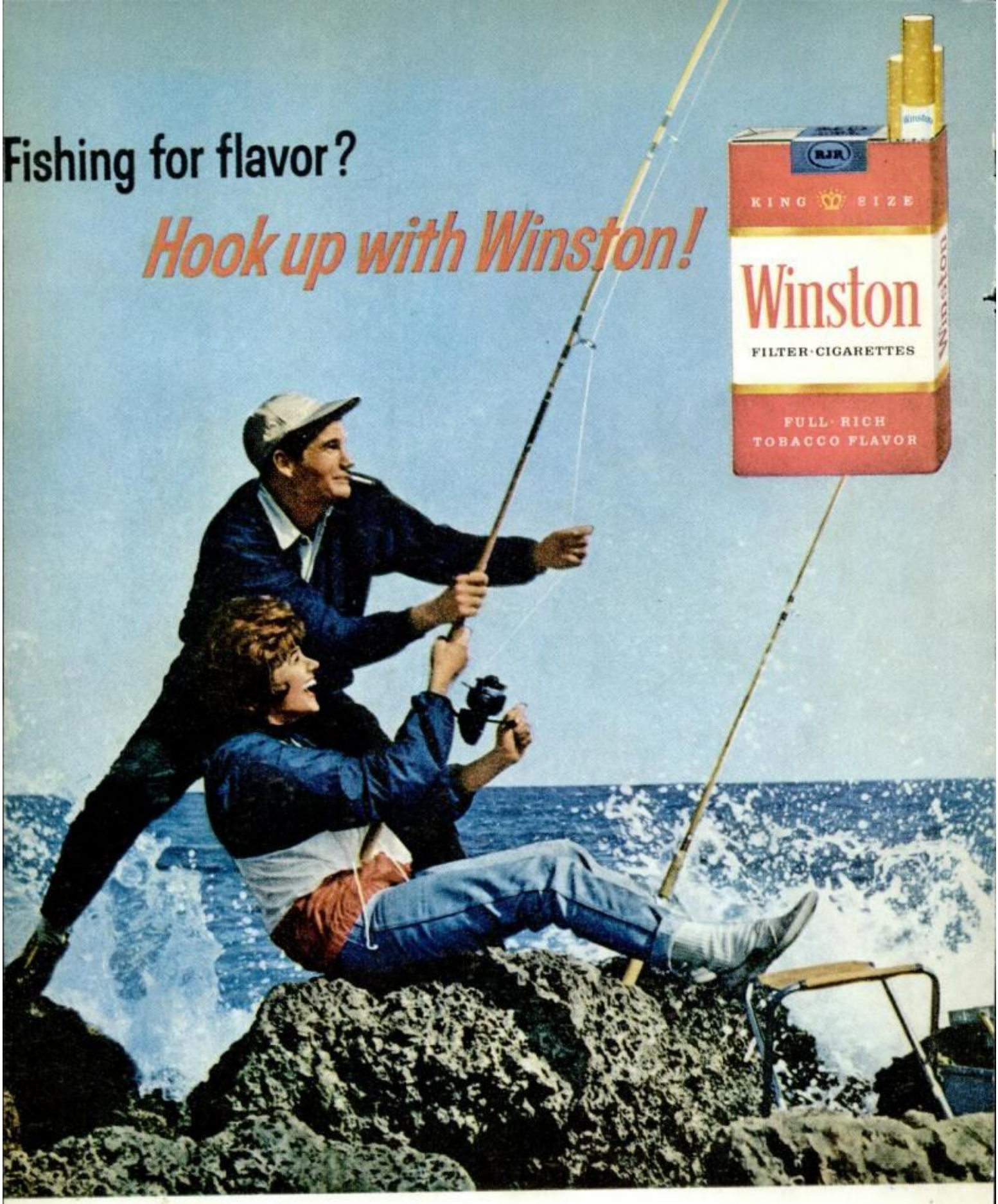

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